MESOSCALE COMPONENTS OF THE GEOSTROPHIC FLOW AND ITS TEMPORAL AND SPATIAL VARIABILITY IN THE CALIFORNIA CURRENT OFF MONTEREY BAY IN 1973-74

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THESIS

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by

Richard Earl Greer

September 1975

Thesis Advisor: J. B. Wickham

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Mesoscale Components of the Geostrophic Flow and Its Temporal and Spatial Variability in the California Current off Monterey Bay in 1973-74		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis; September 1975
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Richard Earl Greer		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		12. REPORT DATE September 1975
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)* Naval Postgraduate School Monterey, California 93940		15. SECURITY CLASS. *(of this report)* Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Geostrophic current
California countercurrent
California current system
Eastern boundary currents
Davidson current
Oceanographic surveys
Geostrophic salt transport

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

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Patterns of current flow indicated by drogues and geostrophy

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Seasonal variations of the geostrophic flow and salt transport were congruent with Skogsberg's [1936] annual cycle composed of three distinct oceanographic seasons.

The flow and structure in the area are complex with flow elements less than 10 km in width. The data suggest that observations on a sampling grid length less than 10 km transverse to the current flow, and extensive independent current measurements are required to describe adequately the small-scale features of the flow, structure and its time variations.

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Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN OCEANOGRAPHY

from the

NAVAL POSTGRADUATE SCHOOL
September 1975

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ACKNOWLEDGEMENT

The author would like to thank several individuals and organizations whose assistance made the overall success of this thesis research possible:

First, my special thanks to Professor Jacob B. Wickham of the Naval Postgraduate School, Monterey, California who provided the raw data, guidance, and advice which facilitated the solution of problems during the conduct of the thesis research.

Lieutenant Commander C. E. Workman, U.S.N., of the Oceanography Section of the Fleet Numerical Weather Center, Monterey, California for his personal assistance which permitted us to utilize the Center's Calma Digitizers.

Professor R. G. Paquette, Oceanography Department, and Ms. Sharon Raney of the Naval Postgraduate School for providing invaluable assistance in computer programming.

Lieutenants Richard E. Blumberg and John G. Hughes, U.S.N., for their efforts in the joint data work-up during the initial stages of the thesis.

Finally, my wife, Pat, for providing encouragement, patience, and her expertise in typing technical reports which allowed me to complete this task on time.

I. INTRODUCTION

Eastern boundary currents, in particular, the California Current, have held the interest of investigators for many years. This is due largely to an avid interest in coastal upwelling, and its important implications on commercial fisheries and related economic enterprises. However, there are other important aspects. Of interest is the poleward countercurrent found close to the prevailing equatorward surface currents. The countercurrent is usually narrower, and found shoreward of the equatorward flow. During the winter months (November through February), and in the absence of prevailing north-northwesterly winds, the poleward countercurrent extends to the surface and is known as the Davidson Current north of Pt. Conception. With the onset of north-northwesterly winds in the spring, upwelling begins to occur along the California coast, and the poleward countercurrent disappears above 200 m. Where the flow is submerged, the countercurrent has been termed an "undercurrent." Of importance is that the poleward countercurrent continues throughout the year at speeds approximately 30 cm/sec or less. Consequently, the water off the California coast tends to have some of the high temperature and salinity characteristics of the low-latitude or "southern waters" (in the Northern Hemisphere). Accordingly, with the poleward transport of warm and salty southern waters, the resulting flow and structure along the California coast will necessarily

be highly complex. In fact, spatially dense observations in consecutive years in a region within 50 km of the continental shelf show a complex structure of southern water undergoing dilution by mixing as it flows northward [Wickham, 1975].

At present, there are many questions still outstanding about the countercurrent, and the resulting highly complex current regime off the California coast. It is the intent of this author to provide answers to a few of them. Specifically, using a data base constructed from spatially dense STD observations off Monterey Bay in 1973-74, an attempt will be made to examine the following,

(1) The patterns of current flow, and their structure with depth,

(2) The temporal variation of the geostrophic flow,

(3) Mesoscale components of the geostrophic current and salt transport.

Additionally, attention will be given to the influence of bottom topography on the direction of flow inside the 1,000 fathom curve, the dependence of geostrophic current on the choice of reference level, and the use of geostrophy to depict small-scale features of the complex flow.

II. THE DATA

A. AREA OF INVESTIGATION AND DATA COLLECTION

The area of investigation is shown in figure 1, in which the major features of the bottom topography are depicted. The major topographical features of the area include Monterey Bay and the Monterey Canyon. The area of investigation lies within the rectangular parallelepiped located just west of the continental shelf off Monterey, California. It extends from the surface to a maximum depth of 725 meters and is bounded by the coordinates, 36° 20'N, 36° 50'N, 122° 00'W, and 123° 00'W.

The data were obtained from thirteen cruises aboard the Acania, the oceanographic vessel of the U.S. Naval Postgraduate School, during the months August 1973 through August 1974. A cruise was conducted once each month during various days of the thirteen-month period. On each cruise observations were made along a horizontal grid much finer than traditionally used in oceanographic surveys to permit increased horizontal definition. Specifically, stations were located along four constant latitude lines normal to the coast at a maximum spacing of 5.6 km between stations; at least one line of stations being occupied on a cruise. Station positions are shown in figure 2, and listed in table I.

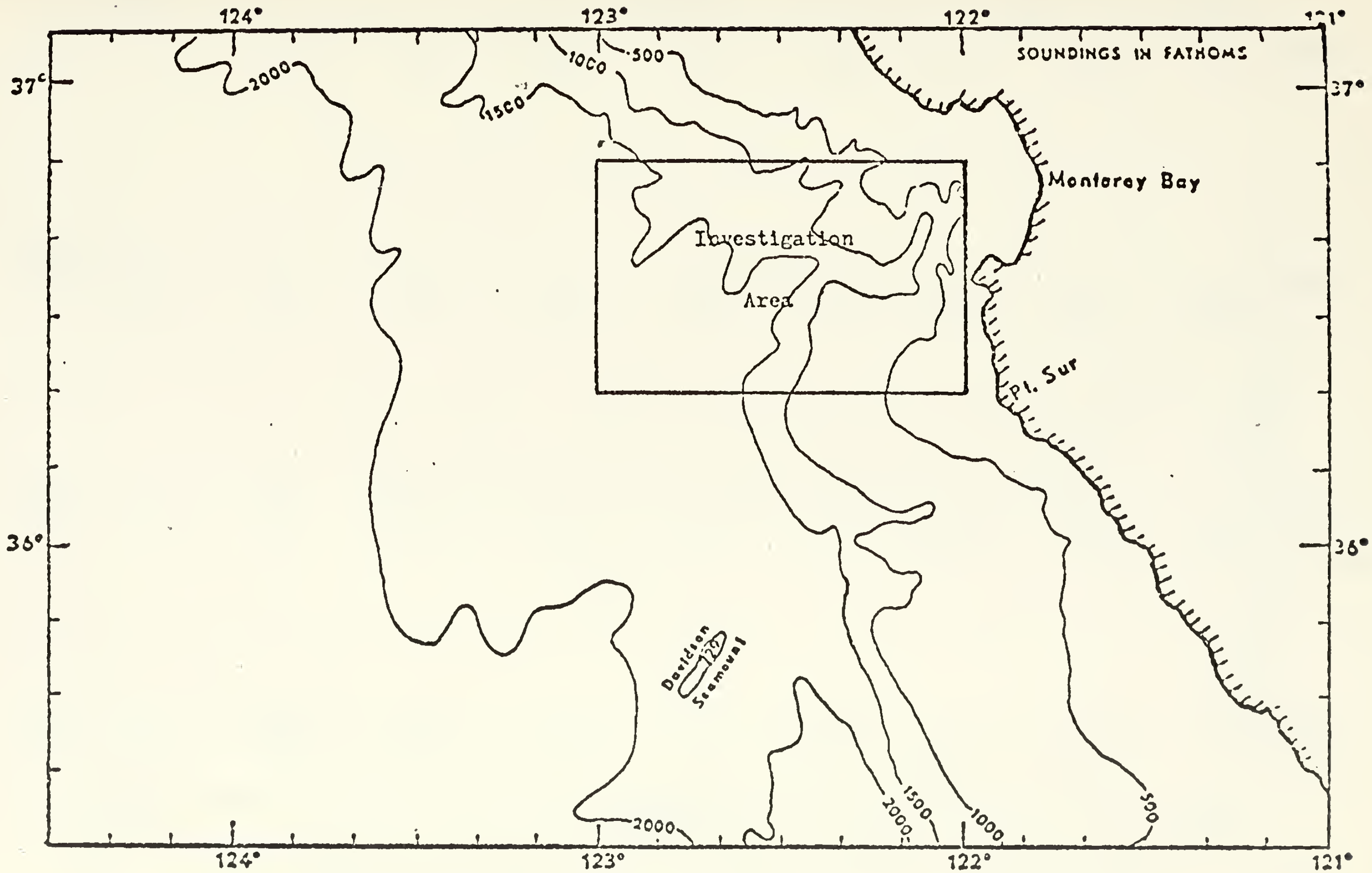


Fig. 1. Major Geographical and Topographical Features of the Investigation area.

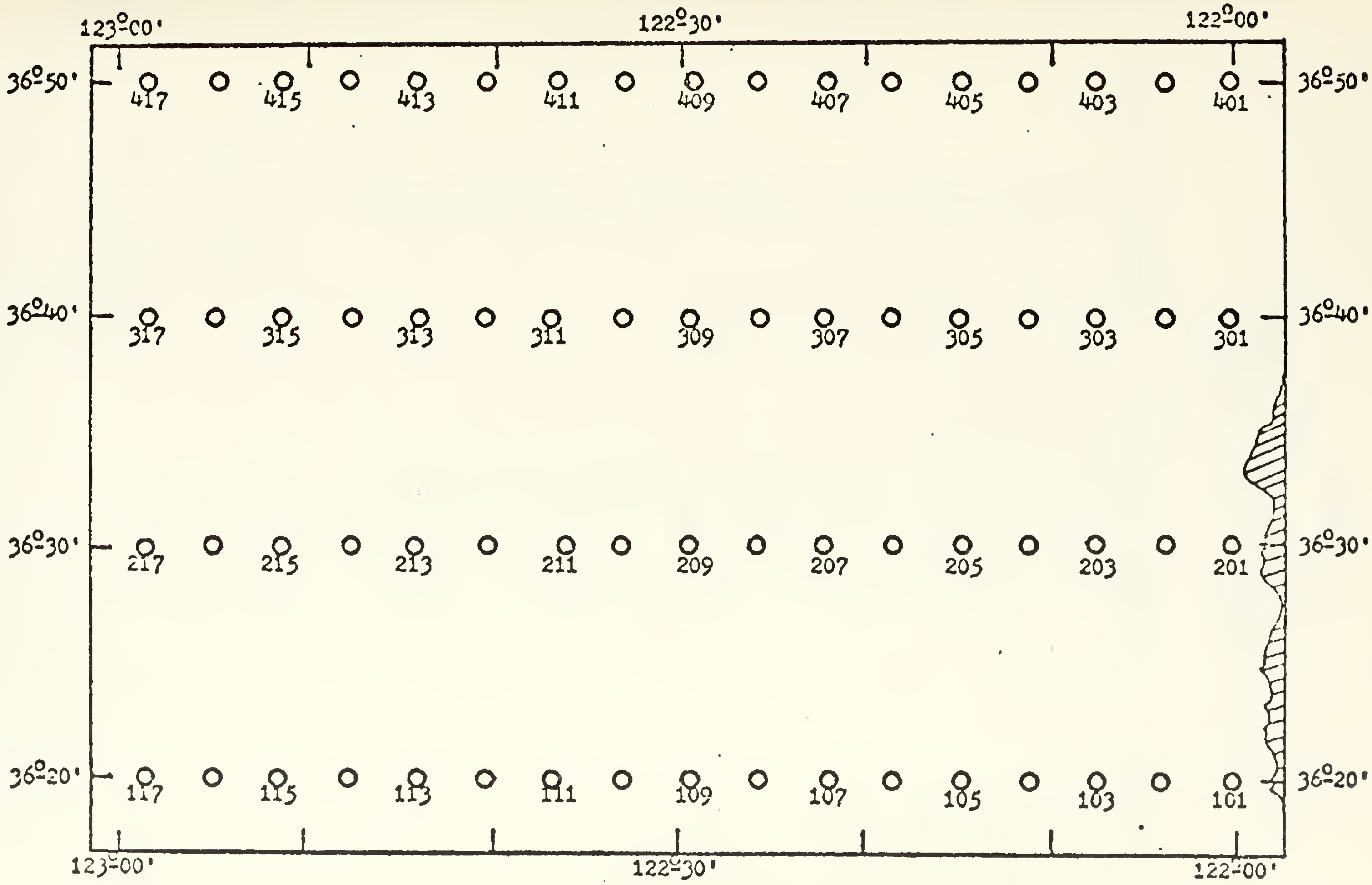


Fig. 2. The Location of Station Positions within the Investigation Area.

TABLE I

LATITUDE AND LONGITUDE OF STATIONS
(August 1973 - August 1974)

Station Numbers	Latitude (North)	Longitude (West)
101	36^{o} 20.0'	122^{o} 00.0'
102	36^{o} 20.0'	122^{o} 03.6'
103	36^{o} 20.0'	122^{o} 07.3'
104	36^{o} 20.0'	122^{o} 10.9'
105	36^{o} 20.0'	122^{o} 14.5'
106	36^{o} 20.0'	122^{o} 18.2'
107	36^{o} 20.0'	122^{o} 21.8'
108	36^{o} 20.0'	122^{o} 25.4'
109	36^{o} 20.0'	122^{o} 29.1'
110	36^{o} 20.0'	122^{o} 32.7'
111	36^{o} 20.0'	122^{o} 36.4'
112	36^{o} 20.0'	122^{o} 40.0'
113	36^{o} 20.0'	122^{o} 43.6'
114	36^{o} 20.0'	122^{o} 47.3'
115	36^{o} 20.0'	122^{o} 50.9'
116	36^{o} 20.0'	122^{o} 54.5'
117	36^{o} 20.0'	122^{o} 58.2'
201 - 217	36^{o} 30.0'	*
301 - 317	36^{o} 40.0'	*
401 - 417	36^{o} 50.0'	*

* Station with same last two digits as 100 series have the same longitude with the exception of station 211, which is located at 36^{o} 30.0'N, and 122^{o} 35.8'W.

B. PROCEDURE

The thirteen cruises aboard the Acania during the period August 1973 through August 1974 provided the data base for this study. Original cruise plans called for all thirteen cruises to utilize the Bissett-Berman continuous profiling STD as the primary observational tool in conjunction with reversing thermometers and Nansen samples, which would provide independent measurements for comparison of temperature and salinity and standardization of the STD. Additionally, expendable bathythermograph (XBT) and surface (bucket) temperatures would provide data for further comparisons. However, due to STD malfunction or in the interest of time-saving the original cruise plans were modified. Specifically, seven cruises utilized the STD as their primary observational tool, while five of the remaining six cruises utilized the XBT. The remaining cruise conducted during April 1974 was terminated early due to equipment malfunction and poor weather conditions.

On STD cruises, a Bissett-Berman continuous profiling instrument (STD) sensed the vertical distributions of temperature and salinity. To obtain vertical definition of approximately two meters, the STD was lowered at a rate of 30 meters per minute. Profiles were recorded for both descent and ascent of the STD so that, during the digitizing of analog traces, spurious spikes in the salinity record could be recognized and eliminated by manual trace smoothing techniques described in the section on data processing. The spikes are known to be caused by a mismatch of time constants between the temperature and conductivity sensors.

On other cruises, expendable bathythermograph (XBT) soundings were utilized to delineate the vertical distributions of temperature. To supplement the XBT temperature data, three Nansen casts were conducted per station line at the eastern, western and mid-sectors of the investigation area. Water samples were taken at the following nine depths: 0, 20, 50, 100, 200, 300, 400, 500 and 750 meters. Obviously, the spacing between hydrocast stations and the interval between water sampling depths did not permit the vertical and horizontal definition of salinity achieved on cruises where the STD was primary. However, hydrocast stations added importantly to the information obtained in the study area.

On all thirteen cruises, independent measurements of temperature and salinity were made, respectively, with reversing thermometers and with laboratory conductivity analysis of sea water samples taken from Nansen bottles. Additionally, surface (bucket) and thermograph temperatures were recorded at each station. These independent measurements and their use are discussed later in the section on data processing.

C. INSTRUMENTATION

The STD instrument used was the Bissett-Berman STD Model 9006. Manufacturer's specifications claim an accuracy of $\pm 0.02^{\circ}C$ and ± 0.02 ppt for temperature and salinity, respectively.

Data were recorded on a continuous analog chart recorder during both descent and ascent of the STD. Data obtained during ascent of the STD were used only to smooth the salinity

record and eliminate false salinity spikes. Although data taken from the up and down casts were in good general agreement, only down trace data were digitized and used for analyses. See Data Processing section for further details.

III. DATA PROCESSING

A. PROCEDURE

Analog strip chart data obtained from the thirteen cruises conducted during August 1973 through August 1974 were manually smoothed, digitized and recorded on a Calma Digitizer 7-track tape recorder. The digitized salinity, temperature and depth data were then read, converted and processed by means of program "DIGISTD" developed for use with the IBM 360 computer. The temperature, salinity and depth data along with calculated values of sound velocity and sigma-t were then grouped according to chronological order and station and written onto 9-track tape. Additionally, salinity and temperature data for every 2.5 meters of depth were output to punched cards for use with a modified version of the HYDRO program to make dynamic height and geostrophic current calculations. These geostrophic current velocities were then used in computations of geostrophic salt transport.

B. DATA PREPARATION

Prior to digitization of the analog data, false salinity spikes caused by the mismatch of time constants between the sensors for temperature and conductivity used to calculate salinity had to be recognized and eliminated. Recognition of spurious salinity spikes was accomplished by comparison of the trace records obtained from the descent and ascent of the STD. Specifically, salinity spikes which were of opposite

sign between the up and down traces of a particular station were assumed to be spurious, and were eliminated. This elimination was accomplished by manually smoothing through the spike along the general trend of the salinity record. This technique involves some qualitative judgment or artistic license; however, salinity trace smoothing was done consistently and appears to represent quite well the true structure. This is borne out by the fact that within the accuracy limitations of the other steps in the digitization process, the densities (sigma-t values) computed from the temperature and smoothed salinity data increased monotonically with increasing depth with few exceptions. The paucity of apparent instabilities, i.e., regions of

$$\frac{d\sigma_t}{dz} < 0 ,$$

and the uniformity of the trace-smoothing process tends to justify the data preparation process.

C. DIGITIZATION

Digitization of the cruise data was a portion of the joint (Greer, Blumberg and Hughes) data work-up. Both the STD and XBT strip chart data obtained from the thirteen cruises conducted during August 1973 through August 1974 were digitized on two Calma Digitizers owned by the Fleet Numerical Weather Center, Monterey, California. The Calma Company Model 480 Digitizer reduces analog graphical data to digital form for computer processing and analysis.

To digitize analog graphical data directly on computer compatible 7-track magnetic tape, the operator selects tracer mode and manually traces the graphical data with a moveable stylus/carriage assembly. The movements of the stylus in the X and Y directions are transmitted to magnetic encoders, which convert the stylus movements in 0.01 inches to digital signals. These signals are processed and formatted for output to 7-track computer magnetic tape. The digital data are recorded on tape at a bit density of 556 BPI.

In addition to the digitization tracer mode, the Calma Digitizer has a manual keyboard entry mode for identification of data on the tape, entering inter-record gaps, record errors, and delete records. The keyboard mode was used in conjunction with each digitized trace segment to identify the particular data station number, month and year, temperature, salinity and depth scales, last trace segment, and whether it was a temperature or salinity trace. Consequently, the output tape was constructed so that every other record was a 13-character keyboard mode entry which identified the following data trace record.

The Calma Digitizer variable interval programmer monitors the output recorder and generates signals every 0.01 inches of stylus movement in the X and Y directions if the stylus is moved at a rate less than 125 inches per minute. At higher rates, the data signals are recorded at 0.02 inches of stylus travel. All cruise data were digitized at 0.01 inches of stylus movement.

The STD data were digitized in segments since the temperature and salinity traces were not continuous due to scale changes in salinity, temperature and depth during collection of the data. Typically, an STD trace consisted of four temperature and two salinity segments. In contrast, the XBT traces consisted of one continuous segment. Consequently, digitizing an STD trace took approximately five times as long as an XBT trace.

D. CALIBRATION AND STANDARDIZATION

On all thirteen cruises, independent measurements of temperature and salinity were made, respectively, with reversing thermometers and with laboratory conductivity analysis of sea water samples taken from Nansen bottles. These independent measurements were used for field calibration of the STD, and to provide standardization of the STD and XBT data permitting qualitative discussion and comparison of the seasonal variation over the thirteen-month period.

In standardizing both the STD and XBT data, the Nansen temperatures and salinities were considered to be the actual or correct temperature and salinity values. Upon examination and comparison of the STD data with the Nansen data, the STD was found to read high in temperature by $0.08^{\circ}C$ for all primary STD data collection months, and low in salinity by 0.04 ppt for data months November 1973 through January 1974, and August 1974. Consequently, the STD temperatures and salinities were decreased and increased respectively to align the STD data with the independent Nansen data.

Standardization of the XBT data was accomplished in a similar manner. However, independent Nansen data were not available, in all cases, for corresponding XBT data stations. Therefore, when corresponding Nansen data were not available, the XBT was corrected to the already standardized STD. Adjustment of the XBT to the standardized STD data made qualitative discussion and comparison of the seasonal variation over the thirteen-month period possible. The corrections were determined by a best-fit curve developed by a computer routine fitting the XBT data with Nansen data when available or with the standardized STD data. Generally, temperature corrections varied from $+0.13^{\circ}C$ to $-0.37^{\circ}C$ for data months August 1973 through August 1974.

E. AUTOMATIC DATA PROCESSING PROGRAMS

Two computer programs, DIGISTD and DIGIXBT, were utilized to read, convert, and process the digitized salinity, temperature and depth data from the 7-track tapes produced on the Calma Digitizers. Both DIGISTD and DIGIXBT are extensively modified versions of an original program MIZ2 by R. G. Paquette. Indicative of their names, DIGISTD processes STD data and DIGIXBT processes expendable bathythermograph data. See appendices A and B for program documentation and listing.

DIGISTD and DIGIXBT convert and store STD and XBT data, respectively, every 0.01 inches of depth on the scale of the digitizer for output to printer, punched card or 9-track tape. Additionally, DIGISTD computes both sound velocity and sigma-t for each set of primary data.

During the data processing phase, all three output media, printer, punched card and 9-track tape, were utilized. Specifically, STD data were output every 0.08 inches of depth (approximately 2.5 meters) to punched card for later direct input into the HYDRO program to compute dynamic heights and geostrophic velocities. Although the number of output data cards produced by punching data points every 2.5 meters appeared to be unwieldy at the outset, this procedure proved manageable, and avoided needless programming problems in getting the correct data off the tape, and in the right order for input to program HYDRO.

F. GEOSTROPHIC CURRENT AND DYNAMIC HEIGHT CALCULATIONS

Geostrophic currents were computed by the dynamic method utilizing a modified version of the computer program, HYDRO, developed for use with the IBM 360 computer by the U.S. Naval Postgraduate School Department of Oceanography. A modified version of the HYDRO program is presented in appendix C. The two basic program modifications are: (1) an increased capability to process temperature and salinity data on a finer vertical scale (approximately 2.5 meters) than traditionally used in oceanographic surveys, and (2) an output card punching routine which produces composite data cards, each containing depth, temperature, salinity, geostrophic velocity, dynamic heights and mass transport values. The composite data cards are useful as input for plotting and contouring computer programs. Specifically, contour and plotting routine, CONTUR, was utilized to display graphically contours of dynamic heights, geostrophic

velocities and geostrophic salt transport on the off-line Calcomp plotter.

Dynamic heights and geostrophic speeds were calculated every ten meters of depth for the first 300 meters of depth, and less frequently for the remaining 200 meters. The ten meter interval proved extremely effective in depicting the complex velocity structure. However, the resulting detailed description of the structure and flow indicated that a larger data interval (every 20 meters for the first 300 meters, and every 50 meters thereafter) would have been sufficient to represent the fine scale structure. Consequently, data in the vertical need not be processed on an interval less than 20 meters. For the investigator processing STD data via cards, this will significantly reduce the number of data cards required for input into HYDRO.

G. GEOSTROPHIC SALT TRANSPORT CALCULATIONS

Geostrophic transport of salt or the salt flux per unit time-area is readily calculated as the product of density, average salinity and geostrophic velocity. Algebraically, the geostrophic salt transport, F_s, may be written as:

$$F_s = (V_{gs})(S)(\rho_{s,t,o}) \tag{1}$$

where

V_{gs} = geostrophic velocity (cm/sec)

S = average salinity (ppt)

$\rho_{s,t,o}$ = density (gm/cm³)

F_s = geostrophic transport of salt (gm/sec-cm²)

The total salt transport, T_s, or salt flux per unit time in area length, ΔX, in a layer of thickness, ΔZ, would be given by,

$$T_S = \int_{\Delta X} \int_{\Delta Z} F_s \, dz \, dx \qquad (2)$$

Values of geostrophic transport of salt were calculated for every 20 meters of depth for the first 300 meters beginning at ten meters, and less frequently from 300 to 500 meters. To obtain an average salinity value corresponding to the geostrophic velocity computed between adjacent stations, an arithmetic mean was used. Specifically, to obtain an average salinity value at ten meters' depth between stations A and B, an arithmetic mean was computed using the surface, 10 and 20 meter salinity values at both adjacent stations A and B. This procedure was used to obtain a representative salinity value between adjacent stations, and to avoid using anomalous values of salinity in the salt transport calculations. The other variable, density, was considered constant over the entire vertical column due to its insignificant effect on the computations. A constant value of 1.026 gm/cm^3 was used for density.

IV. DISCUSSION AND RESULTS

A. THE GEOSTROPHIC CURRENT AND ITS LEVEL OF NO MOTION

The computation of geostrophic currents by the dynamic method has been discussed extensively in physical oceanography texts such as Neumann and Pierson [1966], and Stommel [1965]. The computation scheme is based on an equation derived by Sandström and Helland-Hansen [1903] from Bjerknes Circulation Theorem [1900]. In Oceanography, the equation is widely referred to as the Helland-Hansen equation, and has been extensively used to compute the relative field of currents from the observed field of mass. The equation may be written in terms of the horizontal pressure gradient of the geopotential between two levels P_1 and P_2,

$$V_2 - V_1 = \frac{\int_{P_1}^{P_2} \alpha_A \, dP - \int_{P_1}^{P_2} \alpha_B \, dP}{f \, \Delta X} \qquad (3)$$

where

f = $2\omega \mathrm{SIN}\phi$, the coriolis parameter (1/sec)

ω = the angular velocity of the earth (radians/sec)

ϕ = the geographic latitude (degrees)

ΔX = the distance between stations A and B (kilometers)

α = specific volume (cm^3/gm); subscripts A and B refer to stations A and B

P = pressure (decibars)

$V_2 - V_1$ = the component of horizontal velocity normal to ΔX at P_1 relative to that at P_2 (cm/sec)

Equation (3) may be evaluated to obtain the mean geostrophic flow normal to a horizontal line joining stations A and B. This method permits only the computation of relative velocities. In order to arrive at the absolute currents, either the absolute pressure field or the absolute velocity must be known at least at one level between adjacent stations [Neumann and Pierson, 1966]. The absolute velocity may be found by determining the level or depth at which the currents become zero. In Oceanography, this depth is referred to as the 'level of no motion'. Some methods for estimating this reference level are given in the textbook, The Oceans, by Sverdrup, Johnson and Fleming, 1942, pp. 456-457. However, it is common practice to assume a depth where the currents become zero or to infer it from considerations of continuity.

An obvious way would be to determine the 'level of no motion' by direct measurements. However, this method has limitations due to the presence of other disturbances such as tidal currents, and the difficulty in sensing accurately relatively weak currents. Consequently, several investigators have attempted to corroborate their geostrophic current values, and indirectly their choice of reference level, by independent measurements of the current field by use of parachute drogues. For example, in a study of the California Current System off Baja, California, Reid, Swartzlose and Brown [1963] showed that geostrophic currents computed with respect to a 500 db reference level compared favorably with surface currents independently measured by drogues. On the other hand, other

investigators have found that they agree only roughly. Wickham [1975] in "Observations of the California Countercurrent" found that the local geostrophic current speeds agreed only roughly with the parachute drogue speeds. There are good reasons to expect differences between the actual flow and the results of geostrophy. First, there are obvious non-geostrophic components shown in the drogue speed values; and second, in the investigation area especially near the Monterey Canyon there are large internal waves known to exist, and finally, deformations of the reference isobaric surface (500 db) also must contribute to the difference between actual flow and the results of geostrophy [Wickham, 1975].

For this study, a reference level of 500 db was chosen as the 'level of no motion'. This choice was precipitated by the vertical extent (525 m) of the data in most cases and the success of earlier studies which found the 500 db reference to be suitable for the area.

During the months, January and August 1974, and October through December 1973, STD data were obtained to approximately 735 meters of depth at several stations. These deep station observations permitted geostrophic current calculations using the 700 db, 600 db and the 500 db levels as the reference level of no motion. Tables II through X are the resultant geostrophic currents from the surface to 475 meters relative to the three reference levels, and the velocity shears between the reference levels. To clarify the results contained in Tables II through X, the following variables are defined,

TABLE II

LEVEL OF NO MOTION ANALYSIS

OCTOBER 1973 - STATIONS 317-307

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	1.87	2.56	2.95	-1.08	-0.69	-0.39
10.	1.07	1.76	2.15	-1.08	-0.69	-0.39
20.	-0.20	0.48	0.87	-1.07	-0.68	-0.39
30.	-1.39	-0.71	-0.32	-1.07	-0.68	-0.39
40.	-2.17	-1.49	-1.10	-1.07	-0.68	-0.39
50.	-2.98	-2.29	-1.90	-1.08	-0.69	-0.39
60.	-3.74	-3.06	-2.67	-1.07	-0.68	-0.39
70.	-4.33	-3.64	-3.25	-1.08	-0.69	-0.39
80.	-4.87	-4.18	-3.79	-1.08	-0.69	-0.39
90.	-5.23	-4.54	-4.15	-1.08	-0.69	-0.39
100.	-5.44	-4.75	-4.36	-1.08	-0.69	-0.39
110.	-5.55	-4.86	-4.47	-1.08	-0.69	-0.39
120.	-5.61	-4.93	-4.54	-1.07	-0.68	-0.39
130.	-5.67	-4.98	-4.59	-1.08	-0.69	-0.39
140.	-5.63	-4.95	-4.56	-1.07	-0.68	-0.39
150.	-5.56	-4.88	-4.49	-1.07	-0.68	-0.39
160.	-5.46	-4.78	-4.39	-1.07	-0.68	-0.39
170.	-5.35	-4.67	-4.28	-1.07	-0.68	-0.39
180.	-5.22	-4.54	-4.15	-1.07	-0.68	-0.39
190.	-5.05	-4.36	-3.97	-1.08	-0.69	-0.39
200.	-4.83	-4.14	-3.75	-1.08	-0.69	-0.39
210.	-4.58	-3.90	-3.51	-1.07	-0.68	-0.39
220.	-4.32	-3.64	-3.25	-1.07	-0.68	-0.39
230.	-4.06	-3.38	-2.99	-1.07	-0.68	-0.39
240.	-3.81	-3.12	-2.73	-1.08	-0.69	-0.39
250.	-3.56	-2.87	-2.48	-1.08	-0.69	-0.39
260.	-3.32	-2.64	-2.25	-1.07	-0.68	-0.39
270.	-3.10	-2.42	-2.03	-1.07	-0.68	-0.39
280.	-2.90	-2.22	-1.83	-1.07	-0.68	-0.39
290.	-2.71	-2.02	-1.63	-1.08	-0.69	-0.39
300.	-2.53	-1.84	-1.45	-1.08	-0.69	-0.39
340.	-1.96	-1.27	-0.88	-1.08	-0.69	-0.39
375.	-1.50	-0.82	-0.43	-1.07	-0.68	-0.39
425.	-1.23	-0.54	-0.15	-1.08	-0.69	-0.39
475.	-1.15	-0.46	-0.07	-1.08	-0.69	-0.39

TABLE III

LEVEL OF NO MOTION ANALYSIS

OCTOBER 1973 - STATIONS 307-303

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	0.75	0.95	1.62	-0.87	-0.20	-0.67
10.	-0.20	0.0	0.67	-0.87	-0.20	-0.67
20.	-0.29	-0.09	0.58	-0.87	-0.20	-0.67
30.	-0.73	-0.53	0.14	-0.87	-0.20	-0.67
40.	-1.47	-1.27	-0.60	-0.87	-0.20	-0.67
50.	-2.02	-1.82	-1.15	-0.87	-0.20	-0.67
60.	-2.28	-2.08	-1.41	-0.87	-0.20	-0.67
70.	-2.53	-2.33	-1.66	-0.87	-0.20	-0.67
80.	-2.60	-2.40	-1.73	-0.87	-0.20	-0.67
90.	-2.70	-2.49	-1.82	-0.88	-0.21	-0.67
100.	-2.75	-2.55	-1.88	-0.87	-0.20	-0.67
110.	-2.72	-2.51	-1.84	-0.88	-0.21	-0.67
120.	-2.62	-2.41	-1.74	-0.88	-0.21	-0.67
130.	-2.51	-2.30	-1.63	-0.88	-0.21	-0.67
140.	-2.38	-2.18	-1.51	-0.87	-0.20	-0.67
150.	-2.26	-2.06	-1.39	-0.87	-0.20	-0.67
160.	-2.16	-1.96	-1.29	-0.87	-0.20	-0.67
170.	-2.05	-1.85	-1.18	-0.87	-0.20	-0.67
180.	-1.88	-1.68	-1.01	-0.87	-0.20	-0.67
190.	-1.77	-1.57	-0.90	-0.87	-0.20	-0.67
200.	-1.71	-1.51	-0.84	-0.87	-0.20	-0.67
210.	-1.72	-1.52	-0.85	-0.87	-0.20	-0.67
220.	-1.77	-1.57	-0.90	-0.87	-0.20	-0.67
230.	-1.86	-1.65	-0.98	-0.88	-0.21	-0.67
240.	-1.94	-1.74	-1.07	-0.87	-0.20	-0.67
250.	-1.96	-1.76	-1.09	-0.87	-0.20	-0.67
260.	-1.96	-1.75	-1.08	-0.88	-0.21	-0.67
270.	-1.92	-1.72	-1.05	-0.87	-0.20	-0.67
280.	-1.89	-1.69	-1.02	-0.87	-0.20	-0.67
290.	-1.85	-1.65	-0.98	-0.87	-0.20	-0.67
300.	-1.85	-1.65	-0.98	-0.87	-0.20	-0.67
340.	-2.35	-2.14	-1.47	-0.88	-0.21	-0.67
375.	-2.54	-2.34	-1.67	-0.87	-0.20	-0.67
425.	-2.12	-1.92	-1.25	-0.87	-0.20	-0.67
475.	-1.28	-1.07	-0.40	-0.88	-0.21	-0.67

TABLE IV

LEVEL OF NO MOTION ANALYSIS

NOVEMBER 1973 - STATIONS 317-307

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	-9.86	-9.54	-8.44	-1.42	-0.32	-1.10
10.	-10.22	-9.89	-8.79	-1.43	-0.33	-1.10
20.	-10.58	-10.25	-9.15	-1.43	-0.33	-1.10
30.	-10.79	-10.46	-9.36	-1.43	-0.33	-1.10
40.	-10.60	-10.28	-9.18	-1.42	-0.32	-1.10
50.	-10.69	-10.36	-9.26	-1.43	-0.33	-1.10
60.	-10.80	-10.47	-9.37	-1.43	-0.33	-1.10
70.	-10.74	-10.41	-9.31	-1.43	-0.33	-1.10
80.	-10.49	-10.16	-9.06	-1.43	-0.33	-1.10
90.	-10.23	-9.90	-8.80	-1.43	-0.33	-1.10
100.	-10.00	-9.68	-8.57	-1.43	-0.32	-1.11
110.	-9.79	-9.47	-8.37	-1.42	-0.32	-1.10
120.	-9.64	-9.31	-8.21	-1.43	-0.33	-1.10
130.	-9.45	-9.12	-8.02	-1.43	-0.33	-1.10
140.	-9.25	-8.92	-7.82	-1.43	-0.33	-1.10
150.	-9.06	-8.74	-7.64	-1.42	-0.32	-1.10
160.	-8.89	-8.57	-7.47	-1.42	-0.32	-1.10
170.	-8.73	-8.40	-7.30	-1.43	-0.33	-1.10
180.	-8.54	-8.21	-7.11	-1.43	-0.33	-1.10
190.	-8.32	-8.00	-6.90	-1.42	-0.32	-1.10
200.	-8.13	-7.81	-6.70	-1.43	-0.32	-1.11
210.	-7.91	-7.59	-6.48	-1.43	-0.32	-1.11
220.	-7.67	-7.35	-6.25	-1.42	-0.32	-1.10
230.	-7.43	-7.11	-6.00	-1.43	-0.32	-1.11
240.	-7.17	-6.85	-5.75	-1.42	-0.32	-1.10
250.	-6.92	-6.60	-5.50	-1.42	-0.32	-1.10
260.	-6.66	-6.33	-5.23	-1.43	-0.33	-1.10
270.	-6.37	-6.05	-4.95	-1.42	-0.32	-1.10
280.	-6.09	-5.76	-4.66	-1.43	-0.33	-1.10
290.	-5.87	-5.54	-4.44	-1.43	-0.33	-1.10
300.	-5.63	-5.31	-4.21	-1.42	-0.32	-1.10
340.	-4.59	-4.27	-3.16	-1.43	-0.32	-1.11
375.	-3.77	-3.45	-2.35	-1.42	-0.32	-1.10
425.	-2.74	-2.42	-1.32	-1.42	-0.32	-1.10
475.	-1.82	-1.50	-0.39	-1.43	-0.32	-1.11

TABLE V

LEVEL OF NO MOTION ANALYSIS

NOVEMBER 1973 - STATIONS 307-303

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	6.20	5.23	3.41	2.79	0.97	1.82
10.	6.37	5.40	3.57	2.80	0.97	1.83
20.	6.57	5.60	3.77	2.80	0.97	1.83
30.	6.81	5.84	4.01	2.80	0.97	1.83
40.	7.25	6.28	4.46	2.79	0.97	1.82
50.	8.17	7.20	5.38	2.79	0.97	1.82
60.	8.57	7.60	5.77	2.80	0.97	1.83
70.	8.76	7.79	5.97	2.79	0.97	1.82
80.	8.81	7.85	6.02	2.79	0.96	1.83
90.	8.76	7.79	5.96	2.80	0.97	1.83
100.	8.79	7.82	5.99	2.80	0.97	1.83
110.	8.76	7.79	5.96	2.80	0.97	1.83
120.	8.73	7.76	5.94	2.79	0.97	1.82
130.	8.63	7.66	5.84	2.79	0.97	1.82
140.	8.55	7.58	5.76	2.79	0.97	1.82
150.	8.52	7.55	5.72	2.80	0.97	1.83
160.	8.51	7.55	5.72	2.79	0.96	1.83
170.	8.61	7.64	5.82	2.79	0.97	1.82
180.	8.76	7.79	5.96	2.80	0.97	1.83
190.	8.94	7.97	6.14	2.80	0.97	1.83
200.	9.16	8.19	6.37	2.79	0.97	1.82
210.	9.34	8.37	6.54	2.80	0.97	1.83
220.	9.43	8.46	6.64	2.79	0.97	1.82
230.	9.49	8.52	6.70	2.79	0.97	1.82
240.	9.55	8.58	6.75	2.80	0.97	1.83
250.	9.61	8.64	6.81	2.80	0.97	1.83
260.	9.68	8.71	6.88	2.80	0.97	1.83
270.	9.67	8.70	6.87	2.80	0.97	1.83
280.	9.48	8.51	6.69	2.79	0.97	1.82
290.	9.39	8.42	6.60	2.79	0.97	1.82
300.	9.17	8.20	6.37	2.80	0.97	1.83
340.	7.66	6.69	4.86	2.80	0.97	1.83
375.	6.76	5.79	3.97	2.79	0.97	1.82
425.	5.10	4.13	2.31	2.79	0.97	1.82
475.	3.44	2.47	0.64	2.80	0.97	1.83

TABLE VI

LEVEL OF NO MOTION ANALYSIS

DECEMBER 1973 - STATIONS 307-303

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	-8.21	-6.17	-5.22	-2.99	-2.04	-0.95
10.	-7.92	-5.89	-4.93	-2.99	-2.03	-0.96
20.	-7.57	-5.54	-4.58	-2.99	-2.03	-0.96
30.	-7.01	-4.97	-4.01	-3.00	-2.04	-0.96
40.	-6.06	-4.02	-3.06	-3.00	-2.04	-0.96
50.	-4.75	-2.71	-1.75	-3.00	-2.04	-0.96
60.	-3.91	-1.87	-0.92	-2.99	-2.04	-0.95
70.	-3.35	-1.31	-0.35	-3.00	-2.04	-0.96
80.	-2.93	-0.89	0.07	-3.00	-2.04	-0.96
90.	-2.51	-0.47	0.49	-3.00	-2.04	-0.96
100.	-1.84	0.20	1.16	-3.00	-2.04	-0.96
110.	-1.20	0.84	1.80	-3.00	-2.04	-0.96
120.	-0.82	1.22	2.18	-3.00	-2.04	-0.96
130.	-0.48	1.56	2.52	-3.00	-2.04	-0.96
140.	-0.16	1.87	2.83	-2.99	-2.03	-0.96
150.	0.18	2.22	3.18	-3.00	-2.04	-0.96
160.	0.54	2.58	3.54	-3.00	-2.04	-0.96
170.	0.80	2.83	3.79	-2.99	-2.03	-0.96
180.	0.81	2.85	3.81	-3.00	-2.04	-0.96
190.	0.65	2.69	3.65	-3.00	-2.04	-0.96
200.	0.42	2.46	3.41	-2.99	-2.04	-0.95
210.	0.22	2.26	3.22	-3.00	-2.04	-0.96
220.	0.04	2.08	3.04	-3.00	-2.04	-0.96
230.	-0.05	1.98	2.94	-2.99	-2.03	-0.96
240.	-0.12	1.91	2.87	-2.99	-2.03	-0.96
250.	-0.22	1.82	2.78	-3.00	-2.04	-0.96
260.	-0.32	1.71	2.67	-2.99	-2.03	-0.96
270.	-0.41	1.63	2.58	-2.99	-2.04	-0.95
280.	-0.49	1.54	2.50	-2.99	-2.03	-0.96
290.	-0.59	1.45	2.41	-3.00	-2.04	-0.96
300.	-0.71	1.33	2.29	-3.00	-2.04	-0.96
340.	-0.99	1.05	2.00	-2.99	-2.04	-0.95
375.	-1.19	0.85	1.80	-2.99	-2.04	-0.95
425.	-1.91	0.12	1.08	-2.99	-2.03	-0.96
475.	-2.85	-0.81	0.15	-3.00	-2.04	-0.96

TABLE VII

LEVEL OF NO MOTION ANALYSIS

JANUARY 1974 - STATIONS 317-307

DEPTH (METERS) Z	VELOCITIES (CM./SEC.) VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	-13.66	-13.63	-13.63	-0.03	-0.03	0.0
10.	-14.41	-14.38	-14.38	-0.03	-0.03	0.0
20.	-15.22	-15.20	-15.19	-0.03	-0.02	-0.01
30.	-16.03	-16.01	-16.00	-0.03	-0.02	-0.01
40.	-16.45	-16.42	-16.42	-0.03	-0.03	0.0
50.	-15.98	-15.96	-15.95	-0.03	-0.02	-0.01
60.	-15.29	-15.27	-15.27	-0.02	-0.02	0.0
70.	-14.42	-14.39	-14.39	-0.03	-0.03	0.0
80.	-13.52	-13.50	-13.49	-0.03	-0.02	-0.01
90.	-12.58	-12.56	-12.55	-0.03	-0.02	-0.01
100.	-11.65	-11.63	-11.62	-0.03	-0.02	-0.01
110.	-10.80	-10.78	-10.77	-0.03	-0.02	-0.01
120.	-10.01	-9.98	-9.98	-0.03	-0.03	0.0
130.	-9.19	-9.16	-9.16	-0.03	-0.03	0.0
140.	-8.36	-8.34	-8.33	-0.03	-0.02	-0.01
150.	-7.57	-7.54	-7.54	-0.03	-0.03	0.0
160.	-6.78	-6.75	-6.75	-0.03	-0.03	0.0
170.	-6.06	-6.04	-6.03	-0.03	-0.02	-0.01
180.	-5.41	-5.39	-5.39	-0.02	-0.02	0.0
190.	-4.82	-4.79	-4.79	-0.03	-0.03	0.0
200.	-4.26	-4.24	-4.23	-0.03	-0.02	-0.01
210.	-3.75	-3.73	-3.72	-0.03	-0.02	-0.01
220.	-3.30	-3.27	-3.27	-0.03	-0.03	0.0
230.	-2.93	-2.91	-2.90	-0.03	-0.02	-0.01
240.	-2.67	-2.64	-2.64	-0.03	-0.03	0.0
250.	-2.44	-2.41	-2.41	-0.03	-0.03	0.0
260.	-2.23	-2.20	-2.20	-0.03	-0.03	0.0
270.	-2.04	-2.02	-2.01	-0.03	-0.02	-0.01
280.	-1.86	-1.83	-1.83	-0.03	-0.03	0.0
290.	-1.67	-1.65	-1.64	-0.03	-0.02	-0.01
300.	-1.45	-1.43	-1.42	-0.03	-0.02	-0.01
340.	-0.82	-0.80	-0.79	-0.03	-0.02	-0.01
375.	-0.48	-0.45	-0.45	-0.03	-0.03	0.0
425.	-0.18	-0.16	-0.15	-0.03	-0.02	-0.01
475.	-0.04	-0.02	-0.01	-0.03	-0.02	-0.01

TABLE VIII

LEVEL OF NO MOTION ANALYSIS

JANUARY 1974 - STATIONS 307-303

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	8.06	9.28	9.55	-1.49	-1.22	-0.27
10.	9.21	10.43	10.70	-1.49	-1.22	-0.27
20.	9.93	11.15	11.42	-1.49	-1.22	-0.27
30.	10.28	11.51	11.77	-1.49	-1.23	-0.26
40.	10.50	11.73	12.00	-1.50	-1.23	-0.27
50.	10.69	11.92	12.19	-1.50	-1.23	-0.27
60.	10.82	12.04	12.31	-1.49	-1.22	-0.27
70.	10.86	12.08	12.35	-1.49	-1.22	-0.27
80.	11.09	12.32	12.59	-1.50	-1.23	-0.27
90.	11.56	12.78	13.05	-1.49	-1.22	-0.27
100.	12.00	13.22	13.49	-1.49	-1.22	-0.27
110.	12.48	13.70	13.97	-1.49	-1.22	-0.27
120.	12.89	14.11	14.38	-1.49	-1.22	-0.27
130.	12.92	14.15	14.42	-1.50	-1.23	-0.27
140.	12.39	13.61	13.88	-1.49	-1.22	-0.27
150.	11.48	12.70	12.97	-1.49	-1.22	-0.27
160.	10.21	11.44	11.71	-1.50	-1.23	-0.27
170.	8.97	10.20	10.47	-1.50	-1.23	-0.27
180.	7.79	9.02	9.29	-1.50	-1.23	-0.27
190.	6.60	7.83	8.10	-1.50	-1.23	-0.27
200.	5.45	6.68	6.95	-1.50	-1.23	-0.27
210.	4.28	5.50	5.77	-1.49	-1.22	-0.27
220.	3.15	4.37	4.64	-1.49	-1.22	-0.27
230.	2.26	3.48	3.75	-1.49	-1.22	-0.27
240.	1.61	2.84	3.10	-1.49	-1.23	-0.26
250.	1.09	2.32	2.59	-1.50	-1.23	-0.27
260.	0.60	1.83	2.10	-1.50	-1.23	-0.27
270.	0.18	1.40	1.67	-1.49	-1.22	-0.27
280.	-0.25	0.97	1.24	-1.49	-1.22	-0.27
290.	-0.65	0.57	0.84	-1.49	-1.22	-0.27
300.	-1.06	0.16	0.43	-1.49	-1.22	-0.27
340.	-1.72	-0.50	-0.23	-1.49	-1.22	-0.27
375.	-1.91	-0.68	-0.42	-1.49	-1.23	-0.26
425.	-1.77	-0.55	-0.28	-1.49	-1.22	-0.27
475.	-1.60	-0.38	-0.11	-1.49	-1.22	-0.27

TABLE IX

LEVEL OF NO MOTION ANALYSIS

AUGUST 1974 - STATIONS 317-307

DEPTH (METERS) Z	VELOCITIES (CM./SEC.) VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	-2.22	-1.33	-0.28	-1.94	-0.89	-1.05
10.	-2.30	-1.42	-0.36	-1.94	-0.88	-1.06
20.	-2.40	-1.51	-0.46	-1.94	-0.89	-1.05
30.	-2.78	-1.89	-0.84	-1.94	-0.89	-1.05
40.	-3.41	-2.53	-1.48	-1.93	-0.88	-1.05
50.	-3.76	-2.87	-1.82	-1.94	-0.89	-1.05
60.	-4.11	-3.22	-2.17	-1.94	-0.89	-1.05
70.	-4.34	-3.45	-2.40	-1.94	-0.89	-1.05
80.	-4.48	-3.60	-2.55	-1.93	-0.88	-1.05
90.	-4.56	-3.68	-2.62	-1.94	-0.88	-1.06
100.	-4.50	-3.62	-2.56	-1.94	-0.88	-1.06
110.	-4.39	-3.51	-2.46	-1.93	-0.88	-1.05
120.	-4.35	-3.47	-2.42	-1.93	-0.88	-1.05
130.	-4.31	-3.43	-2.38	-1.93	-0.88	-1.05
140.	-4.32	-3.44	-2.38	-1.94	-0.88	-1.06
150.	-4.26	-3.38	-2.32	-1.94	-0.88	-1.06
160.	-4.23	-3.35	-2.30	-1.93	-0.88	-1.05
170.	-4.22	-3.34	-2.28	-1.94	-0.88	-1.06
180.	-4.22	-3.33	-2.28	-1.94	-0.89	-1.05
190.	-4.20	-3.32	-2.27	-1.93	-0.88	-1.05
200.	-4.17	-3.29	-2.24	-1.93	-0.88	-1.05
210.	-4.15	-3.26	-2.21	-1.94	-0.89	-1.05
220.	-4.12	-3.24	-2.19	-1.93	-0.88	-1.05
230.	-4.12	-3.24	-2.19	-1.93	-0.88	-1.05
240.	-4.12	-3.23	-2.18	-1.94	-0.89	-1.05
250.	-4.11	-3.23	-2.18	-1.93	-0.88	-1.05
260.	-4.12	-3.24	-2.19	-1.93	-0.88	-1.05
270.	-4.13	-3.25	-2.19	-1.94	-0.88	-1.06
280.	-4.11	-3.23	-2.17	-1.94	-0.88	-1.06
290.	-4.08	-3.19	-2.14	-1.94	-0.89	-1.05
300.	-4.04	-3.16	-2.11	-1.93	-0.88	-1.05
340.	-3.79	-2.91	-1.85	-1.94	-0.88	-1.06
375.	-3.47	-2.59	-1.54	-1.93	-0.88	-1.05
425.	-2.83	-1.94	-0.89	-1.94	-0.89	-1.05
475.	-2.22	-1.33	-0.28	-1.94	-0.89	-1.05

TABLE X

LEVEL OF NO MOTION ANALYSIS

AUGUST 1974 - STATIONS 307-303

DEPTH (METERS)	VELOCITIES (CM./SEC.)					
Z	VEL.7,Z	VEL.6,Z	VEL.5,Z	VEL.7,5	VEL.7,6	VEL.6,5
0.	-18.97	-15.56	-11.88	-7.09	-3.41	-3.68
10.	-19.03	-15.61	-11.93	-7.10	-3.42	-3.68
20.	-19.16	-15.75	-12.06	-7.10	-3.41	-3.69
30.	-19.22	-15.80	-12.12	-7.10	-3.42	-3.68
40.	-19.12	-15.70	-12.02	-7.10	-3.42	-3.68
50.	-19.15	-15.74	-12.06	-7.09	-3.41	-3.68
60.	-18.82	-15.41	-11.73	-7.09	-3.41	-3.68
70.	-18.41	-14.99	-11.31	-7.10	-3.42	-3.68
80.	-17.98	-14.56	-10.88	-7.10	-3.42	-3.68
90.	-17.84	-14.42	-10.74	-7.10	-3.42	-3.68
100.	-17.70	-14.29	-10.60	-7.10	-3.41	-3.69
110.	-17.49	-14.07	-10.39	-7.10	-3.42	-3.68
120.	-17.19	-13.78	-10.10	-7.09	-3.41	-3.68
130.	-16.86	-13.45	-9.77	-7.09	-3.41	-3.68
140.	-16.63	-13.21	-9.53	-7.10	-3.42	-3.68
150.	-16.47	-13.05	-9.37	-7.10	-3.42	-3.68
160.	-16.22	-12.80	-9.12	-7.10	-3.42	-3.68
170.	-16.00	-12.58	-8.90	-7.10	-3.42	-3.68
180.	-15.78	-12.36	-8.68	-7.10	-3.42	-3.68
190.	-15.51	-12.10	-8.42	-7.09	-3.41	-3.68
200.	-15.23	-11.81	-8.13	-7.10	-3.42	-3.68
210.	-14.95	-11.54	-7.85	-7.10	-3.41	-3.69
220.	-14.72	-11.30	-7.62	-7.10	-3.42	-3.68
230.	-14.49	-11.08	-7.40	-7.09	-3.41	-3.68
240.	-14.27	-10.86	-7.17	-7.10	-3.41	-3.69
250.	-13.97	-10.56	-6.87	-7.10	-3.41	-3.69
260.	-13.65	-10.23	-6.55	-7.10	-3.42	-3.68
270.	-13.33	-9.91	-6.23	-7.10	-3.42	-3.68
280.	-12.99	-9.57	-5.89	-7.10	-3.42	-3.68
290.	-12.65	-9.23	-5.55	-7.10	-3.42	-3.68
300.	-12.32	-8.91	-5.23	-7.09	-3.41	-3.68
340.	-11.23	-7.81	-4.13	-7.10	-3.42	-3.68
375.	-10.32	-6.91	-3.22	-7.10	-3.41	-3.69
425.	-9.17	-5.75	-2.07	-7.10	-3.42	-3.68
475.	-7.84	-4.43	-0.75	-7.09	-3.41	-3.68

Z = depth (m)

VEL.Z = absolute velocity at Z (cm/sec).[1]

VEL.7 = absolute velocity at Z = 700 m (cm/sec)

VEL.5 = absolute velocity at Z = 500 m (cm/sec)

VEL.7,Z = velocity at Z relative to 700 m (cm/sec)

VEL.5,Z = velocity at Z relative to 500 m (cm/sec)

VEL.7,5 = velocity at 500 m relative to velocity at 700 m or the velocity shear between Z = 500 m and Z = 700 m

VEL.6,5 = velocity at 500 m relative to velocity at 600 m or the velocity shear between Z = 500 m and Z = 600 m

The preceding variables are related to each other in that the absolute velocity at any depth, Z, is equal to the absolute velocity at Z = 700 m plus the velocity at Z relative to 700 m, or symbolically,

$$\text{VEL.Z} = \text{VEL.7} + \text{VEL.7,Z} \tag{4}$$

similarly,

$$\text{VEL.Z} = \text{VEL.6} + \text{VEL.6,Z} \tag{5}$$

$$\text{VEL.Z} = \text{VEL.5} + \text{VEL.5,Z} \tag{6}$$

subtracting equation (6) from (4),

$$0 = \text{VEL.7} - \text{VEL.5} + \text{VEL.7,Z} - \text{VEL.5,Z}$$

or,

$$\text{VEL.5} - \text{VEL.7} = \text{VEL.7,Z} - \text{VEL.5,Z} \tag{7}$$

---

[1] In fact, velocities are defined on isobaric surfaces where the pressure in db is roughly the same numerically as the given depth in meters. Negative velocities indicate flow to the north in Tables II through X.

but the left-hand side of equation (7) is the velocity shear between Z = 500 m and Z = 700 m or,

VEL.7,5 = VEL.7,Z - VEL.5,Z

The velocities at Z relative to 700 db, 600 db and 500 db are known from dynamic method computations. Thus the velocity shears which provide quantitative differences between the two levels are known. Now, assuming that the 500 db level is the reference level which provides velocities which nearly approximate the actual flow, then comparison of the velocity shears, VEL.7,5 and VEL.6,5, to the velocity at Z relative to 500 m, VEL.5,Z, respectively, provides a velocity error percentage. For example, Table II shows that if one chose 700 db as a reference level instead of 500 db, the assumed correct level, the calculated surface currents would differ by 37 percent. As expected, the difference percentage tends to increase with greater depths.

In summary, Tables II through X show quantitatively that there are considerable differences in current speeds obtained from geostrophy using 500 db, 600 db, and 700 db as the reference levels. Consequently, if the objective of a study is to obtain current speeds which are correct in magnitude, the selection of a 'level of no motion' should not be a matter of choice but of direct measurement, and of data corroboration via independent measurements. The apparent influence of bottom topography on the flow (see subsection B in Discussion and Results) also suggests that motion persists rather deeper than 500 db and that there may be no simple 'level of no motion'.

B. PATTERNS OF CURRENT FLOW AND THEIR STRUCTURE WITH DEPTH

The patterns of current flow are inferred from geostrophy with respect to the 500 db surface. To obtain a pictorial representation of the current flow and its structure with depth, dynamic heights for data stations along three constant latitude lines, 36^{o} 20'N, 36^{o} 30'N and 36^{o} 40'N, were plotted and height contours drawn for the isobaric surface, 50 db, 100 db, 200 db, 300 db, 375 db and the 425 db surfaces during August 1973. These dynamic height contours of the various surfaces above are shown in figures 3 through 9. The contour lines are labeled with their respective dynamic height values in dynamic centimeters. The contour intervals for each of figures 3 through 9 are different. Consequently, caution should be exercised when interpreting the figures for speed. For example, the closely spaced contours in figures 8 and 9 do not indicate an intense circulation.

Unfortunately, this analysis could not be accomplished for data months other than August 1973 since data observations were made predominantly along one constant latitude line, 36^{o} 40'N, during months September 1973 through August 1974. However, the contours clearly reveal some interesting features of the patterns of the current flow and their structure with depth during August 1973.

The prominent features depicted in figures 3 through 9 are,

(1) The flow branches into a northwesterly and an east-southeasterly component just north of 36^{o} 30'N at all seven depths from the surface to 425 meters.

(2) The general pattern of current flow is similar for all depths from the surface to 375 meters.

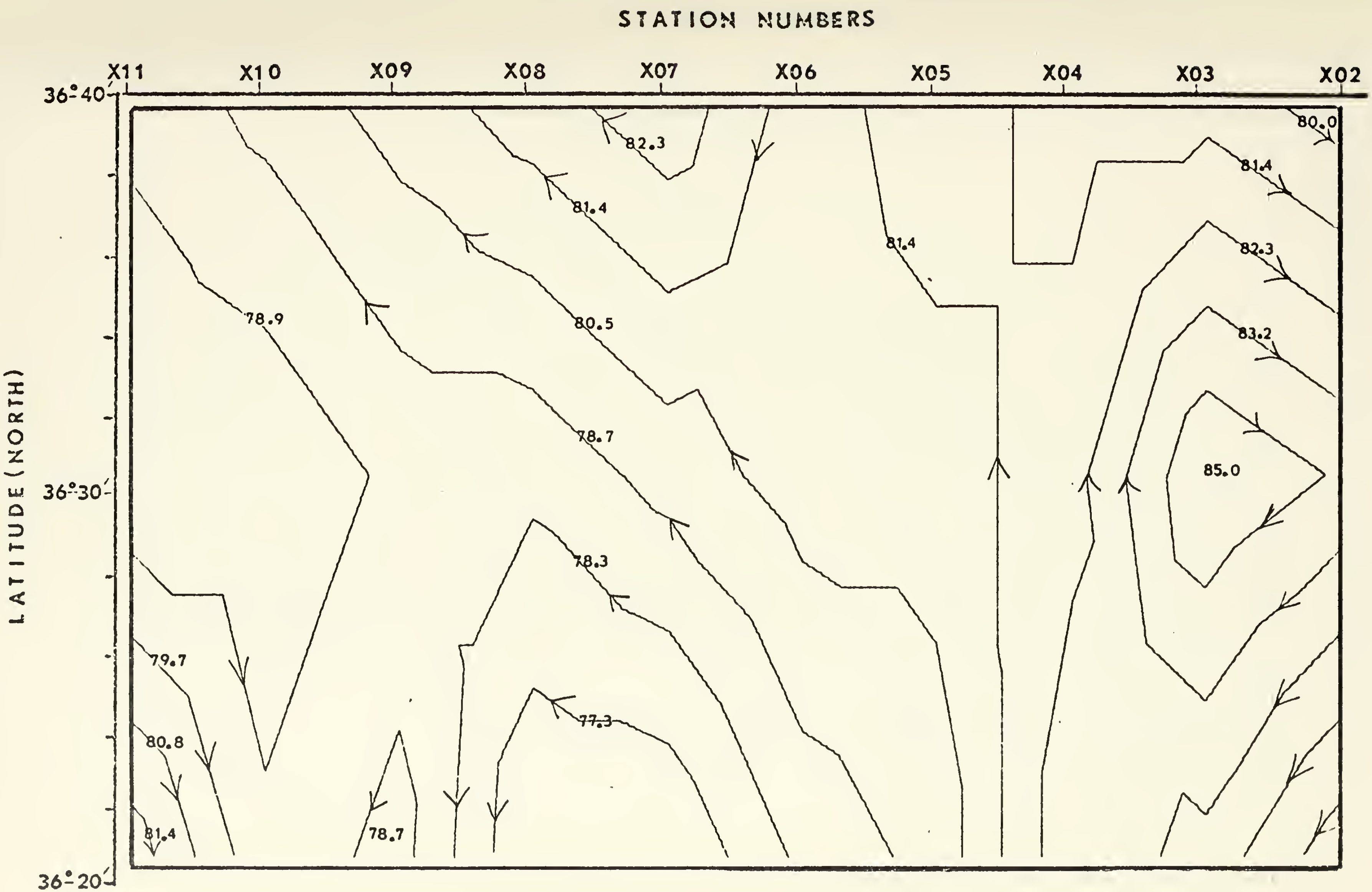


Fig. 3. Dynamic Height Contours at the Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

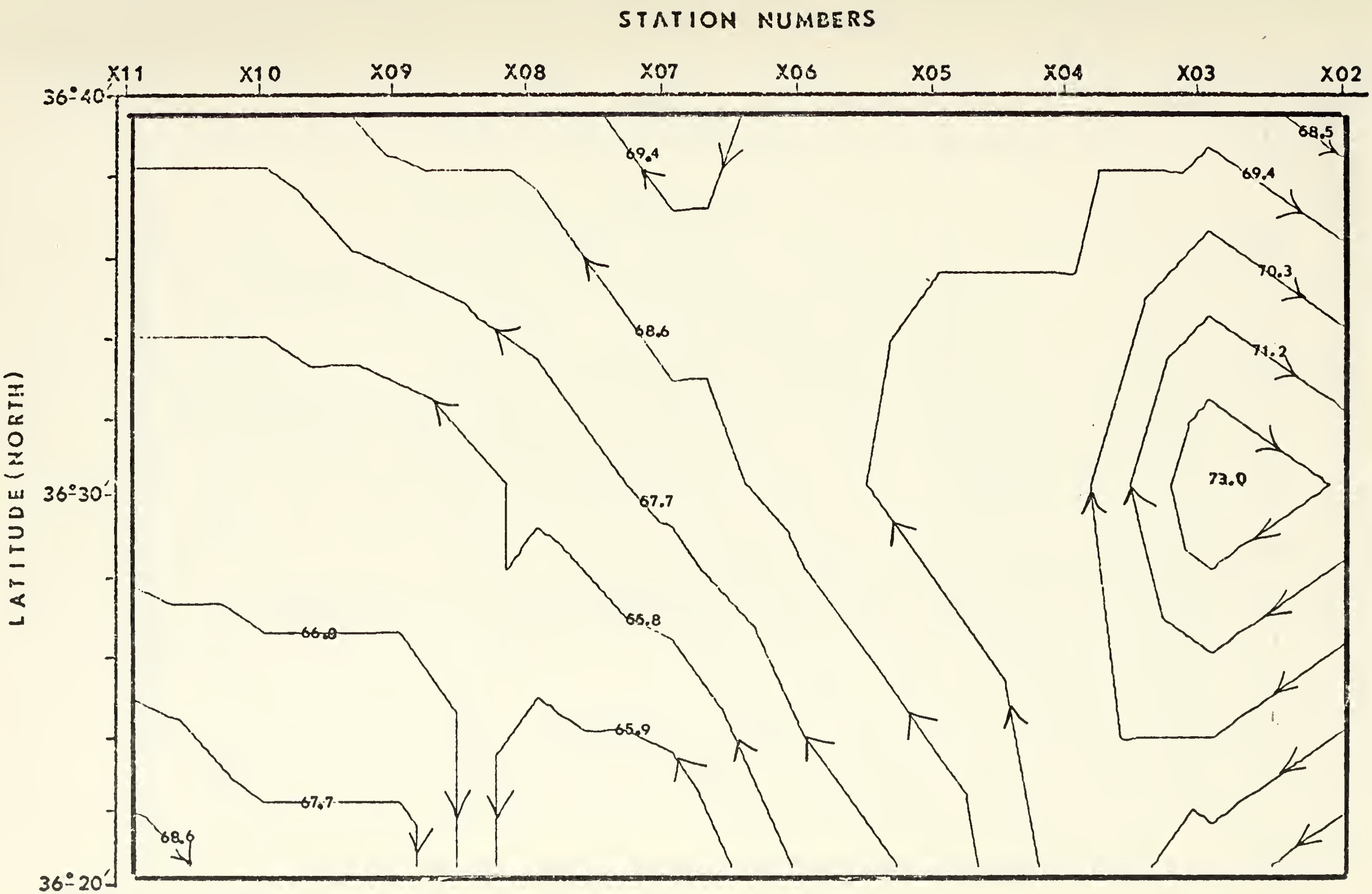


Fig. 4. Dynamic Height Contours of the 50 db Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

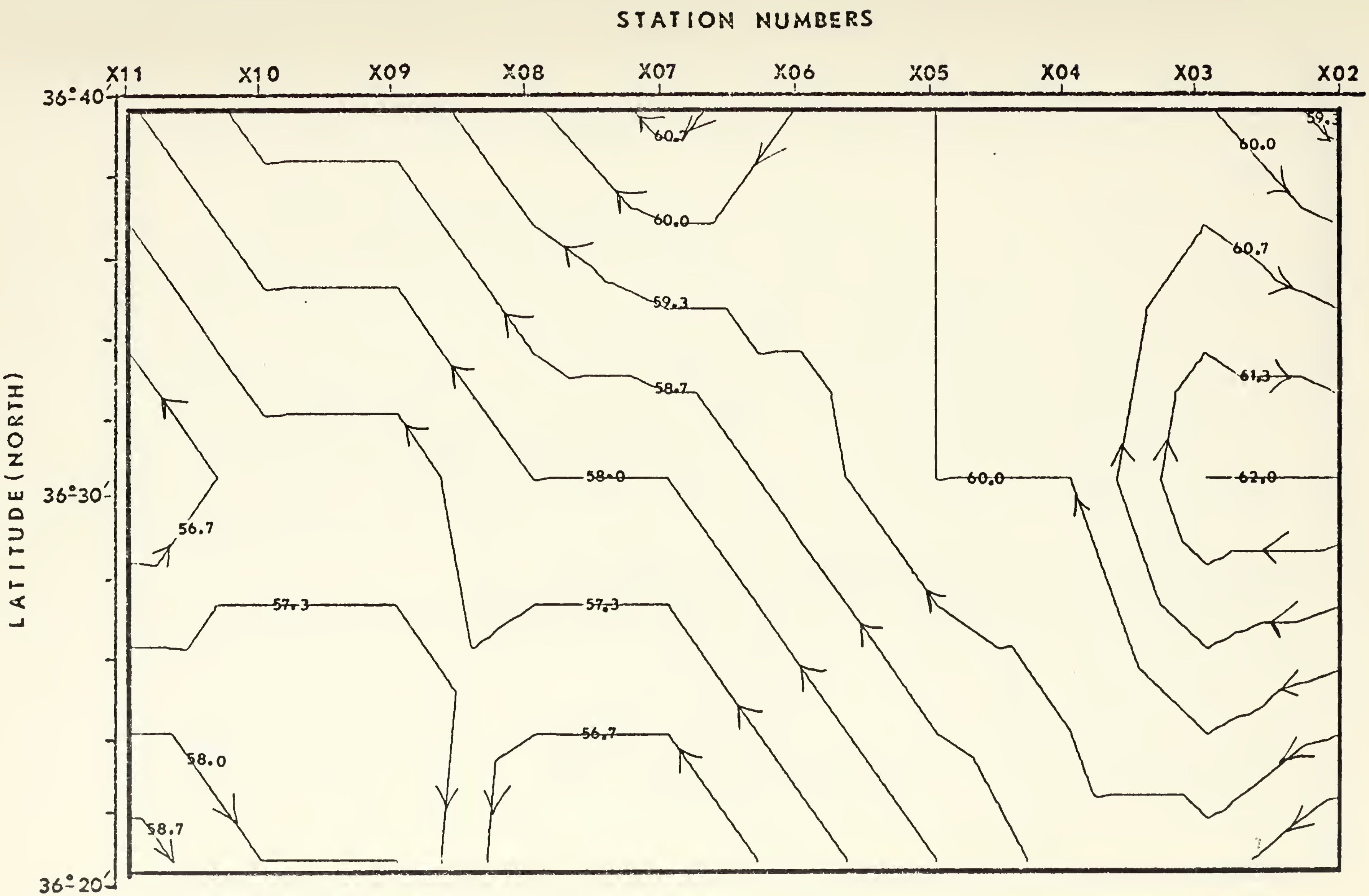


Fig. 5. Dynamic Height Contours of the 100 db Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

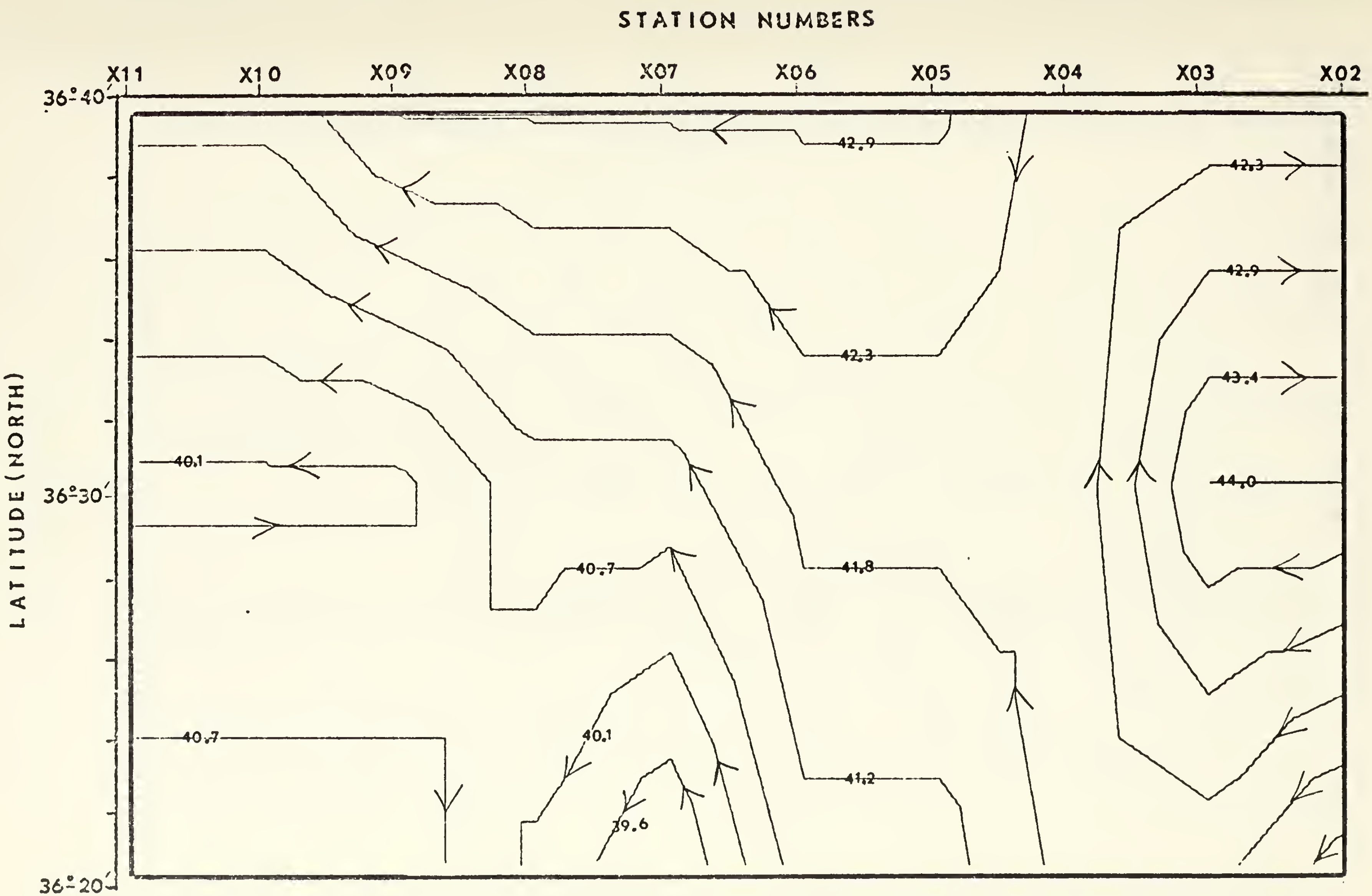


Fig. 6. Dynamic Height Contours of the 200 db Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

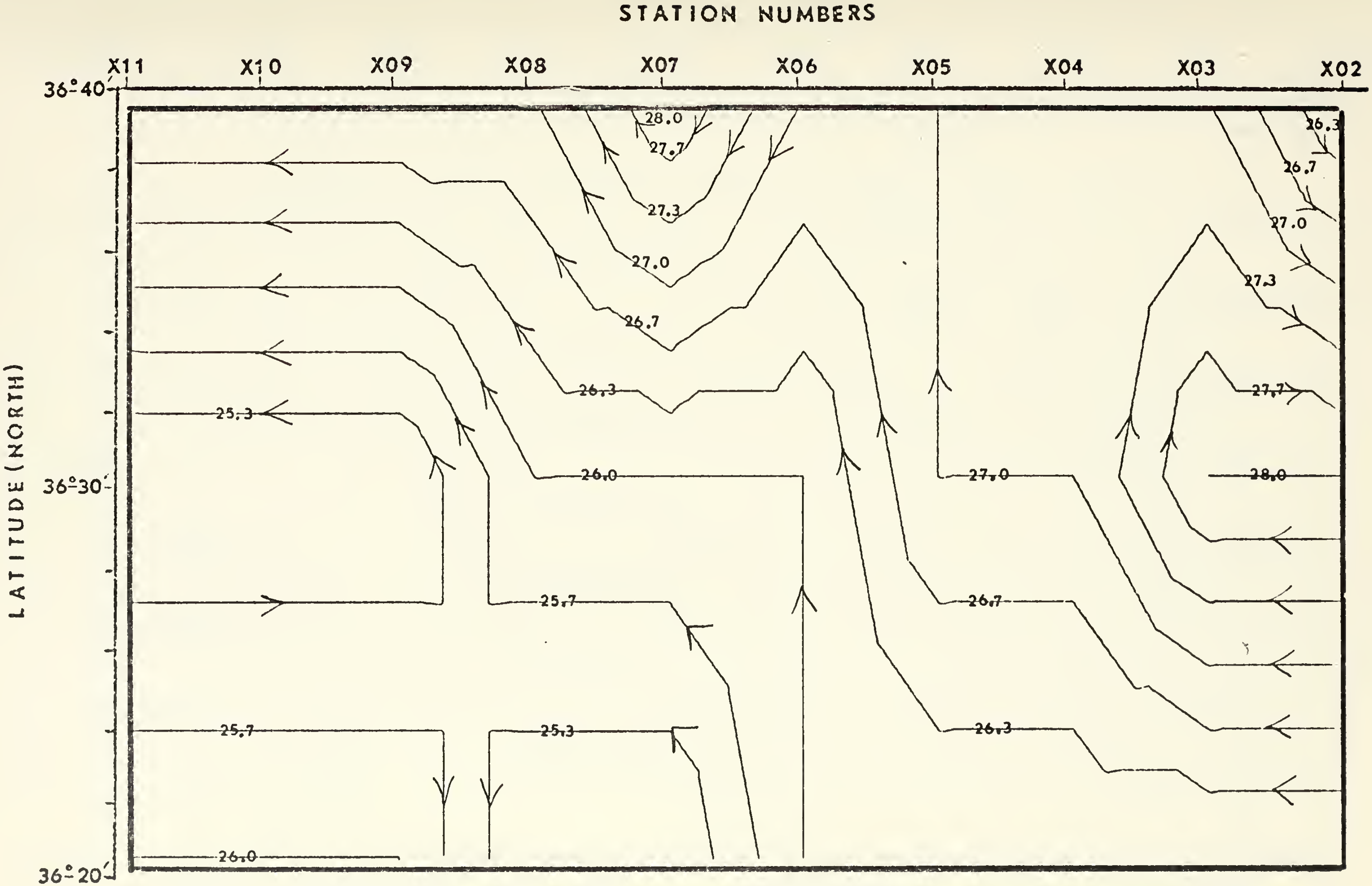


Fig. 7. Dynamic Height Contours of the 300 db Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

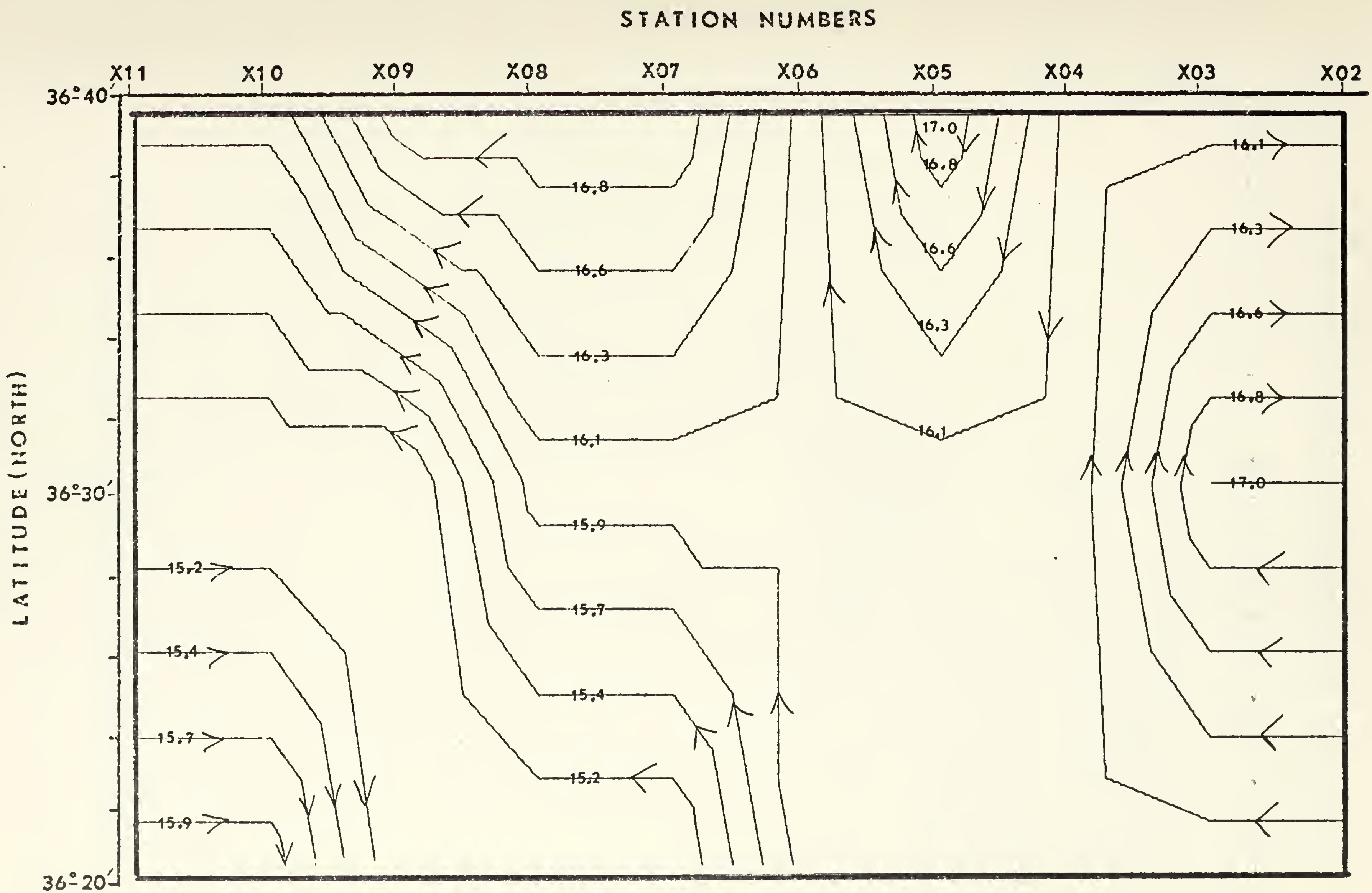


Fig. 8. Dynamic Height Contours of the 375 db Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

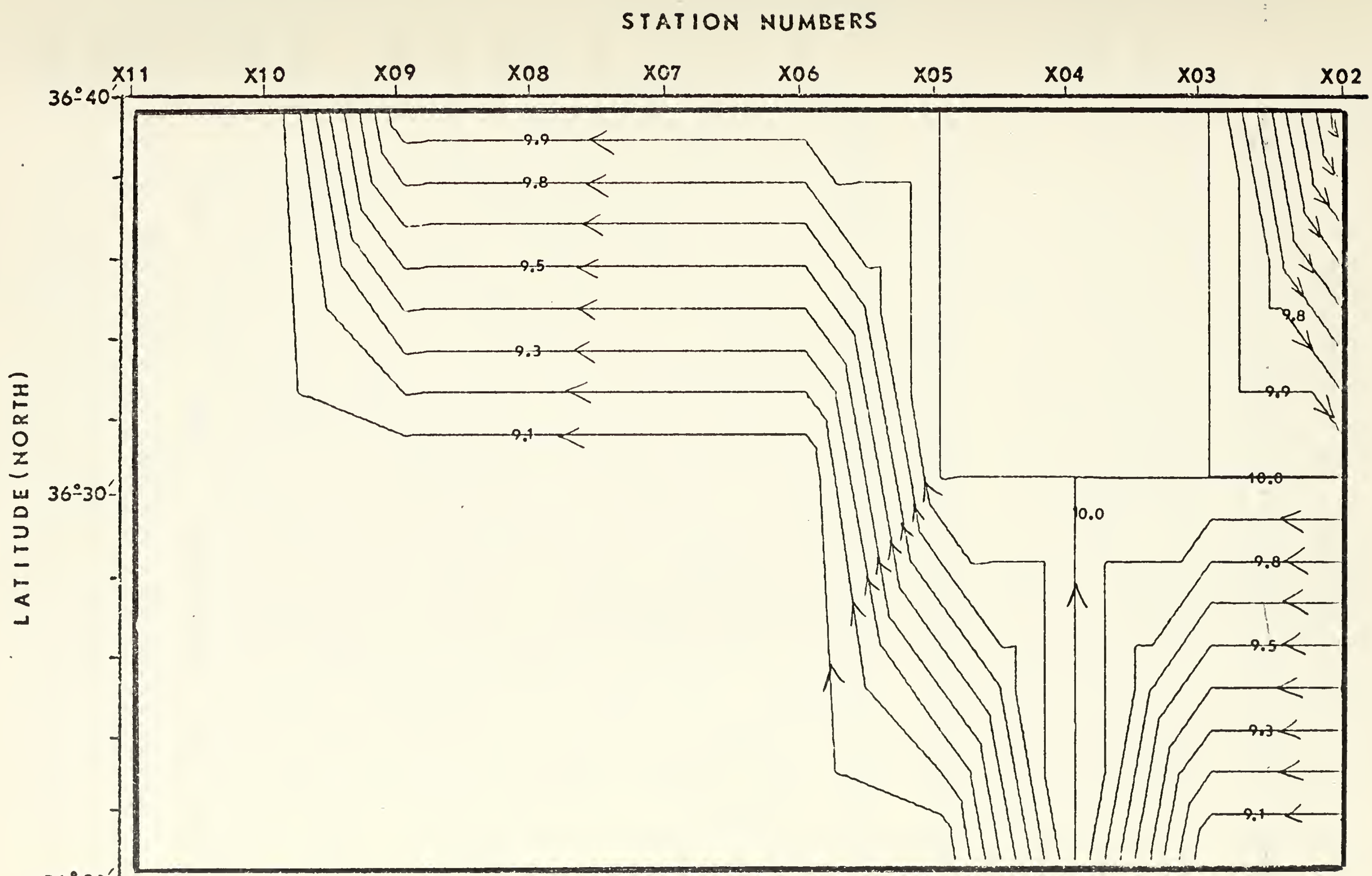


Fig. 9. Dynamic Height Contours of the 425 db Surface during August 1973. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

(3) The flow is more intense south of latitude 36° 30'N as evidenced by the dynamic height contour spacing.

(4) The narrow band of poleward flow in the vicinity of longitude 122° 18'W, near stations 106 and 206, appears to be topographically controlled.

Figure 10 depicts the general pattern of current flow relative to the local bathymetry. Figures 3 through 10 suggest that the course of the currents in this area is controlled in part by the local bottom topography. This is evidenced in the following ways,

(1) The flow follows the general north-south topographical orientation south of 36° 30'N.

(2) The flow branches north of 36° 30'N, and follows the generally east-west bathymetric contours.

Furthermore, the currents in the northwest sector of the area appear not to be topographically controlled. This can be explained by the fact that the current speed for the most part is small near 500 m, and it would be difficult to see how bottom topography at depths greater than 1,000 fathoms could influence the currents in this sector. However, in the northeastern sector, where depth decreases toward the coastline, the currents appear to be topographically controlled and follow the principle of conservation of potential vorticity.

Now consider the validity of the current flow inferred from geostrophy. Independent current flow measurements were made using parachute drogues during August 1972 and August 1973 by Wickham [1975]. Drogue trajectories, especially in 1972, confirm that the flow branches into two components, and there appears to be a narrow band of poleward flow in the vicinity of longitude 122° 18'W; and the drogue paths in

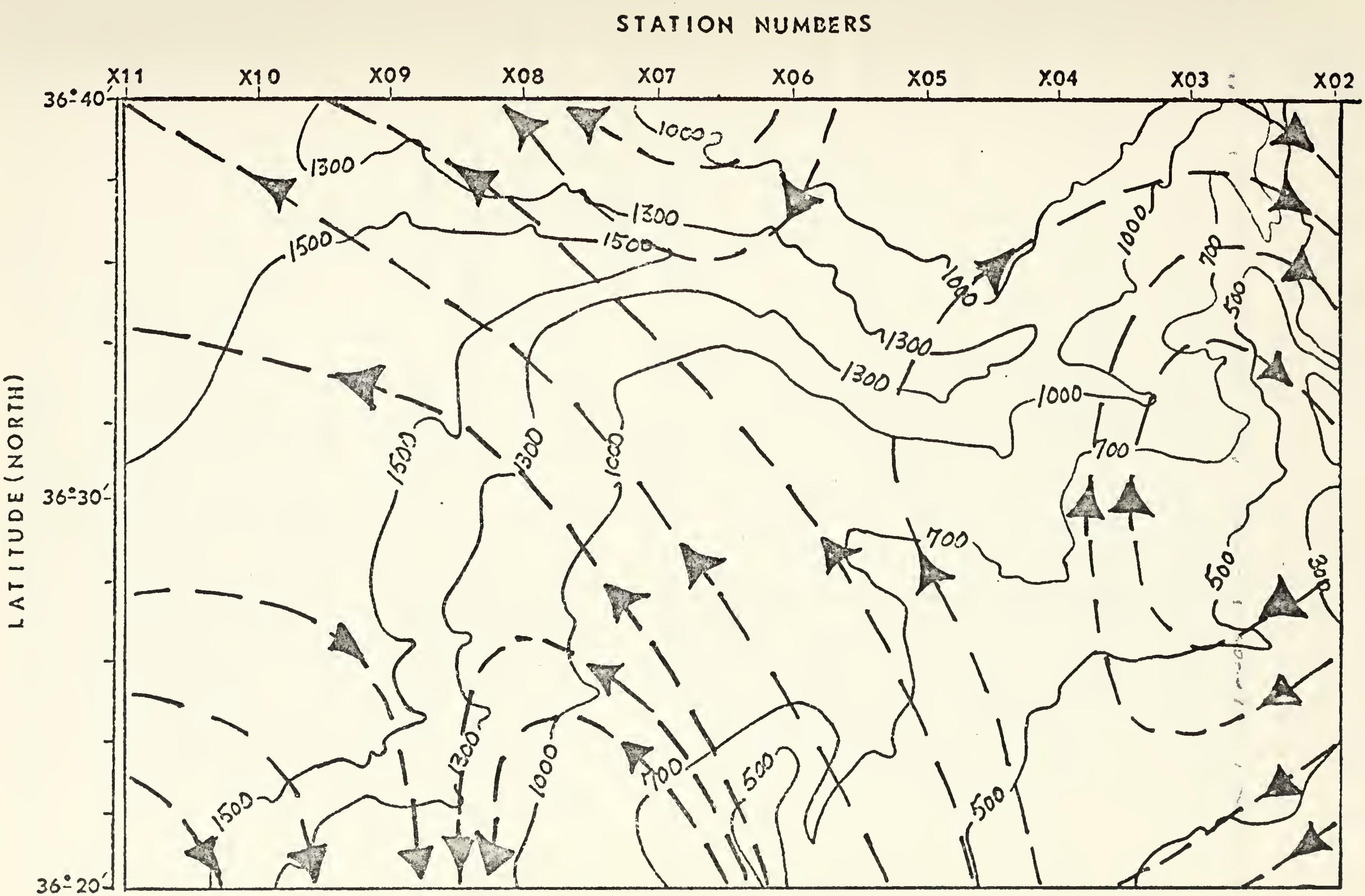


Fig. 10. General Pattern of Geostrophic Current Flow during August 1973.

August 1973 tend to confirm a broader poleward flow towards the west. There is also indication in the drogue paths in August 1972 of a strong shear zone and a cyclonic eddy of similar scale to that shown by geostrophy in 1973.

C. TEMPORAL VARIATION OF THE GEOSTROPHIC FLOW

The variation of the geostrophic flow with time is inferred from geostrophic calculations with respect to the 500 db surface. Specifically, dynamic heights were calculated for stations along constant latitude line, 36° 40'N, during each month. These dynamic heights were used to generate a two-dimensional array with the abscissa and ordinate axes specified as station numbers and time, respectively. Dynamic height contours were then constructed for several isobaric surfaces and the geostrophic flow normal to the station line inferred from the contours.

Originally, the dynamic height contours with time were to depict temporal variations over the entire observation period, August 1973 through August 1974. However, the time period had to be divided into two segments due to programming constraints of the program routine, CONTUR. Specifically, the program will contour only the dynamic height values of data months which have an equal number of data stations. Consequently, data months February, June and July 1974, which have dynamic height calculations based on only three Nansen data stations, (vice 16 STD stations for the other months) prohibited depicting variation of flow over the entire time period. Therefore figures 11 through 16, which were constructed from dynamic

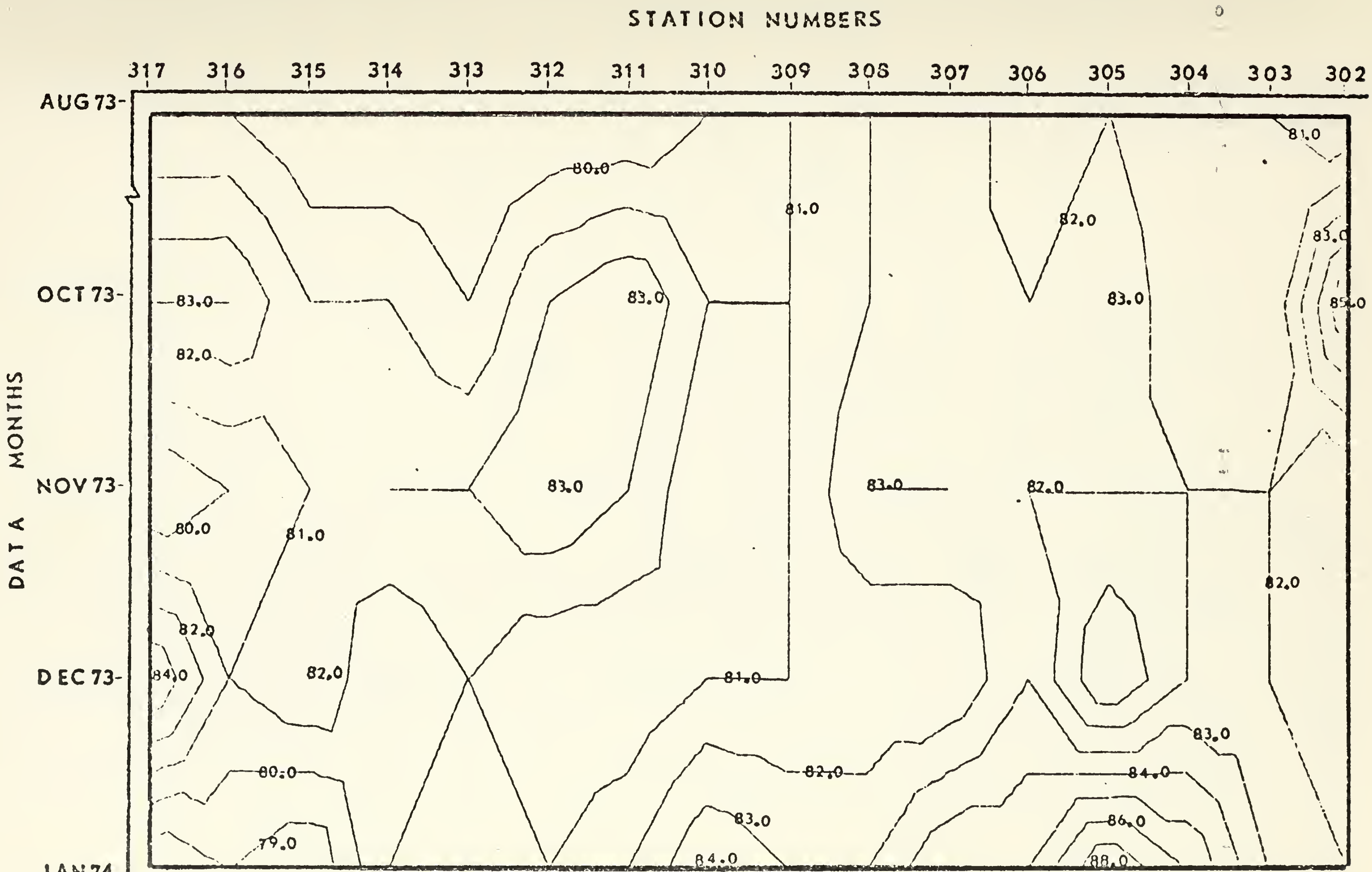


Fig. 11. Temporal Variation of Dynamic Height Contours at the Surface for August 1973 through January 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

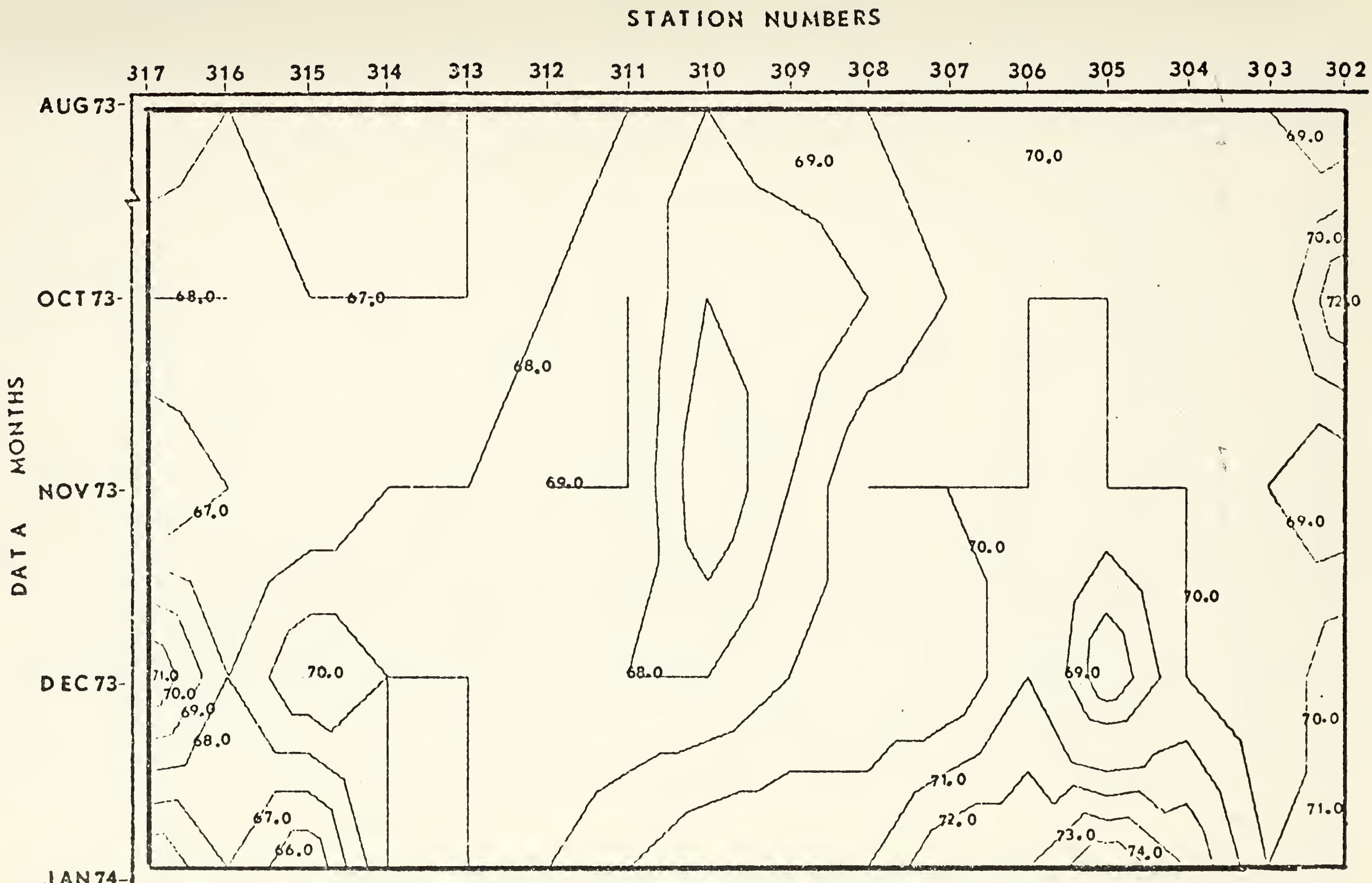


Fig. 12. Temporal Variation of Dynamic Height Contours of the 50 db Surface for August 1973 through January 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

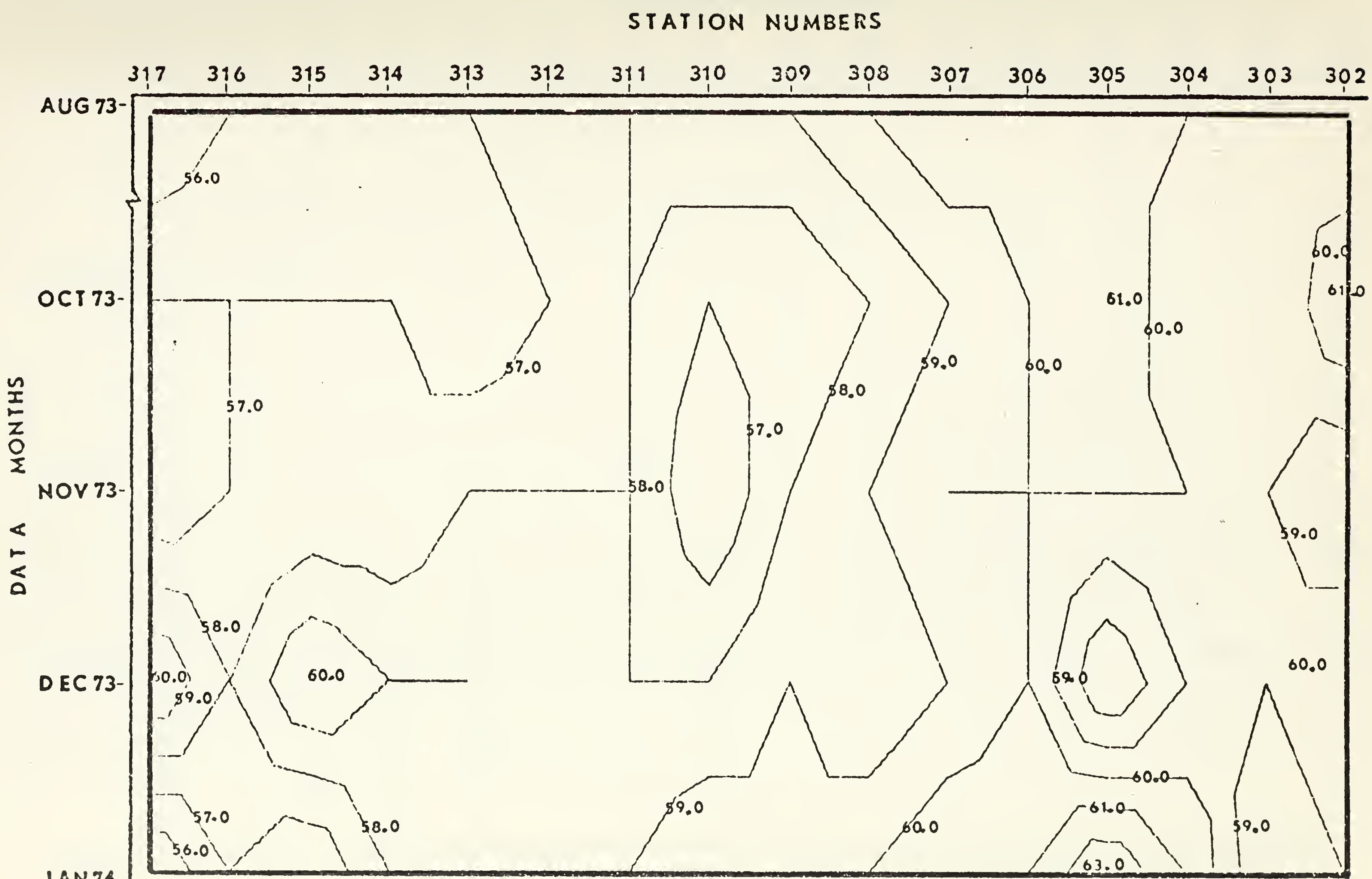


Fig. 13. Temporal Variation of Dynamic Height Contours of the 100 db Surface for August 1973 through January 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

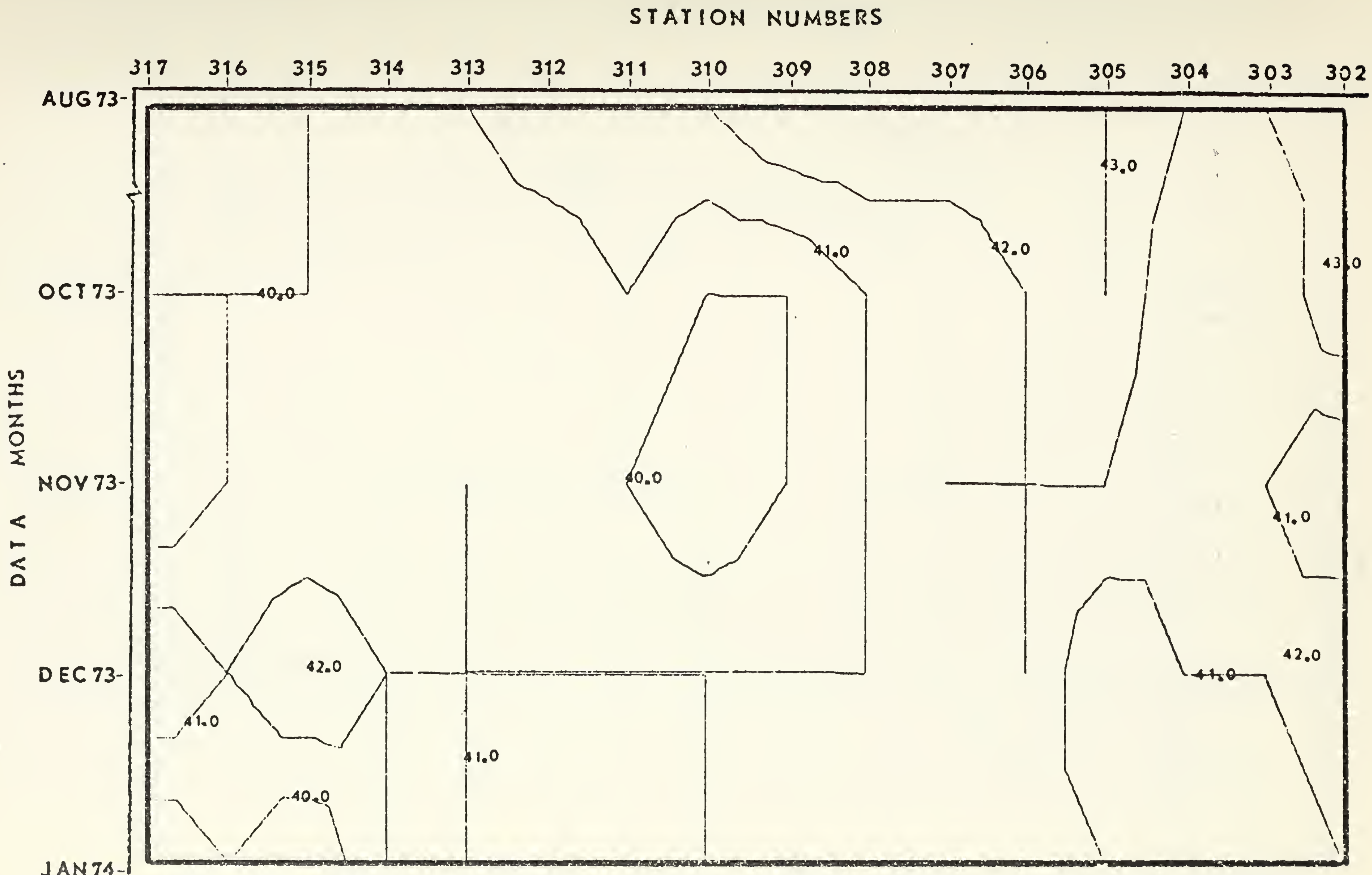


Fig. 14. Temporal Variation of Dynamic Height Contours of the 200 db Surface for August 1973 through January 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

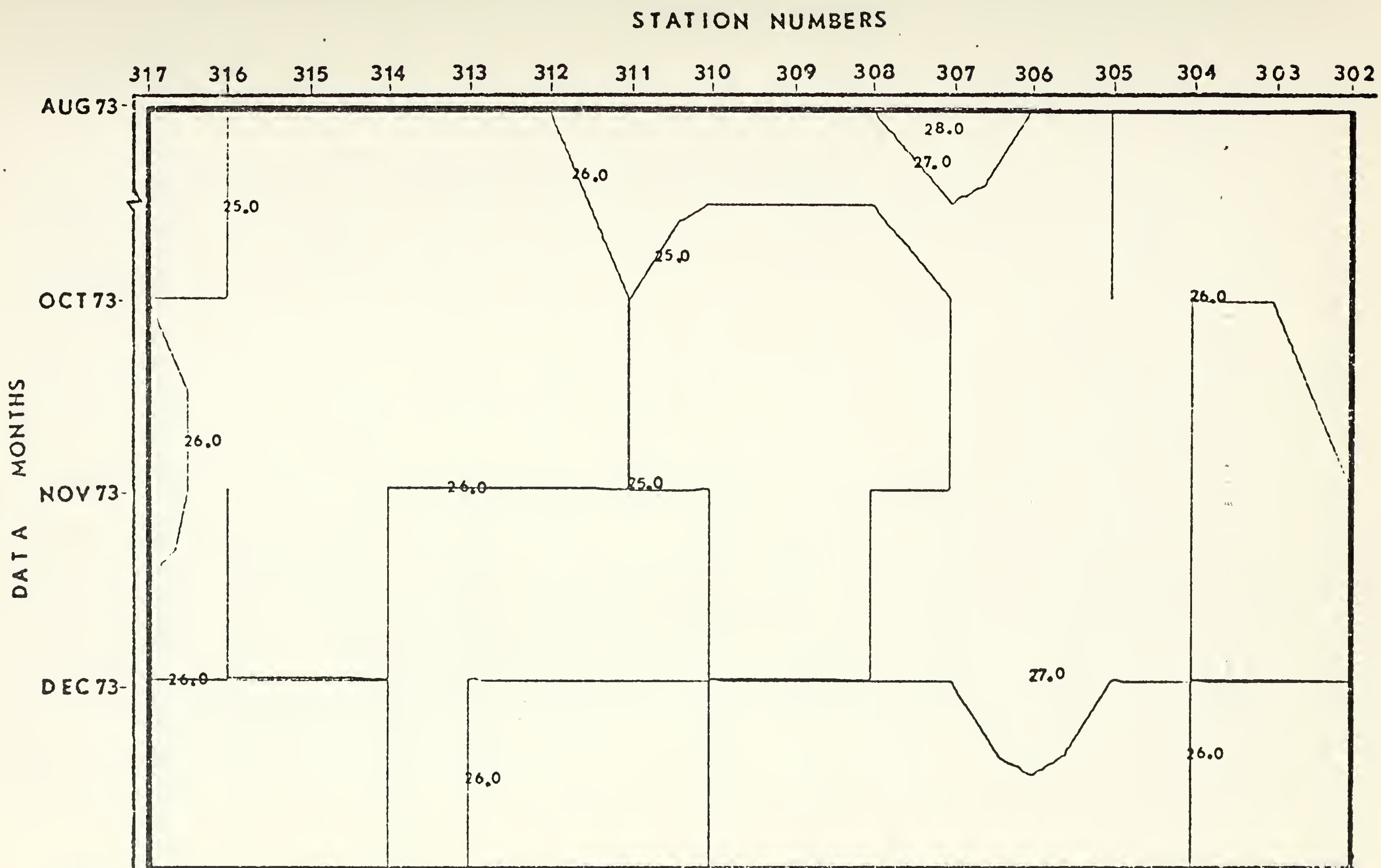


Fig. 15. Temporal Variation of Dynamic Height Contours of the 300 db Surface for August 1973 through January 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

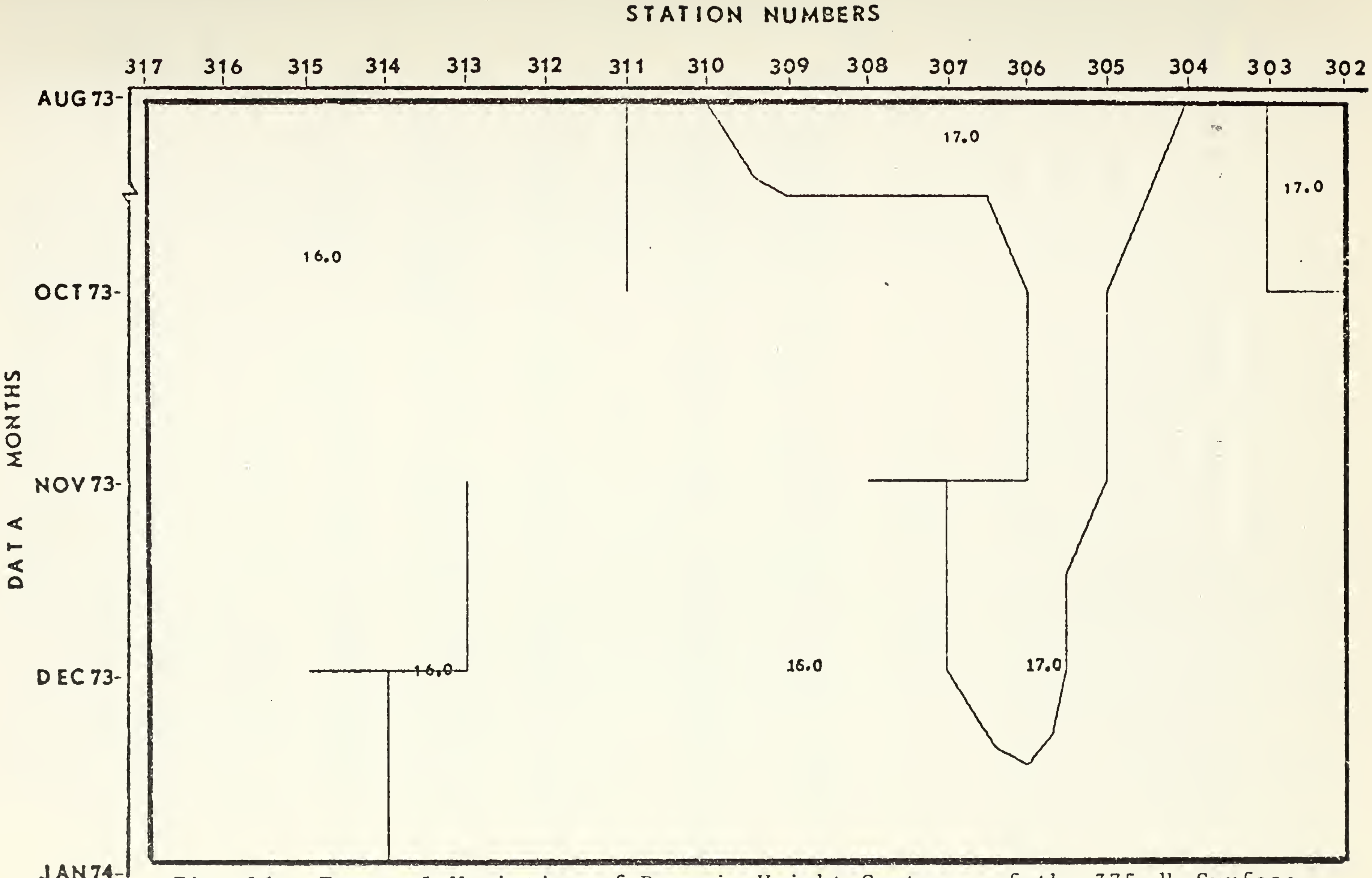


Fig. 16. Temporal Variation of Dynamic Height Contours of the 375 db Surface for August 1973 through January 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

height values based on 16 STD stations per data cruise month, depict the temporal variation of geostrophic flow at several depths for only the period, August 1973 through January 1974. Figures 17 through 21, which were constructed from dynamic height values based on either STD or Nansen data at three data stations per data cruise month, depict the temporal variation of geostrophic flow at several depths over the period January 1974 through August 1974.

The prominent features depicted in figures 11 through 16 are,

(1) The general surface flow pattern over the time period, August 1973 through January 1974, is very similar to those found at 50 m, 100 m, 200 m and 300 m.

(2) The geostrophic flow is more intense during the period November 1973 through January 1974 than during August through October 1973 in the upper 200 meters of depth.

(3) The poleward flow appears to shift to the west with time.

(4) The equatorward flow, east of station number 309, during December 1973 through January 1974 appears to be more intense in the upper 200 meters than the poleward flow.

(5) A reversal in the flow direction is depicted in the vicinity of station 305 such that the predominant flow east of station 305 is equatorward, and poleward west of the station.

(6) A narrow band of poleward flow located between stations 306 and 309 is apparent throughout the period, and from the surface to 375 m.

Now consider figures 17 through 21. Obviously, the small scale structure revealed in figures 11 through 16 cannot be seen in figures 17 through 21 due to the data observation grid size. However, there are a few features that are apparent.

(1) The flow is more intense during January, June and August 1974 than during February, March and July 1974.

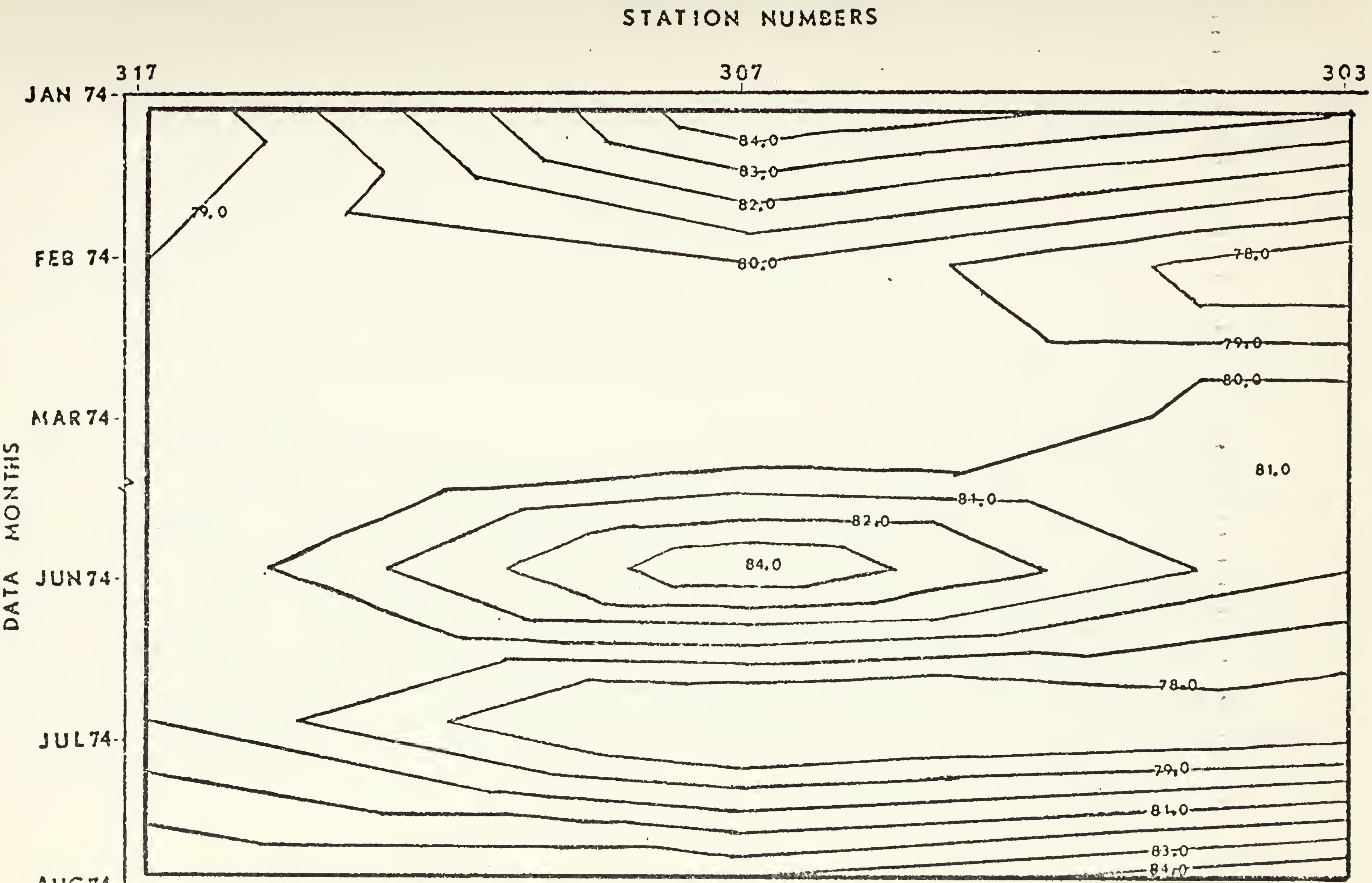


Fig. 17. Temporal Variation of Dynamic Height Contours at the Surface for January 1974 through August 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

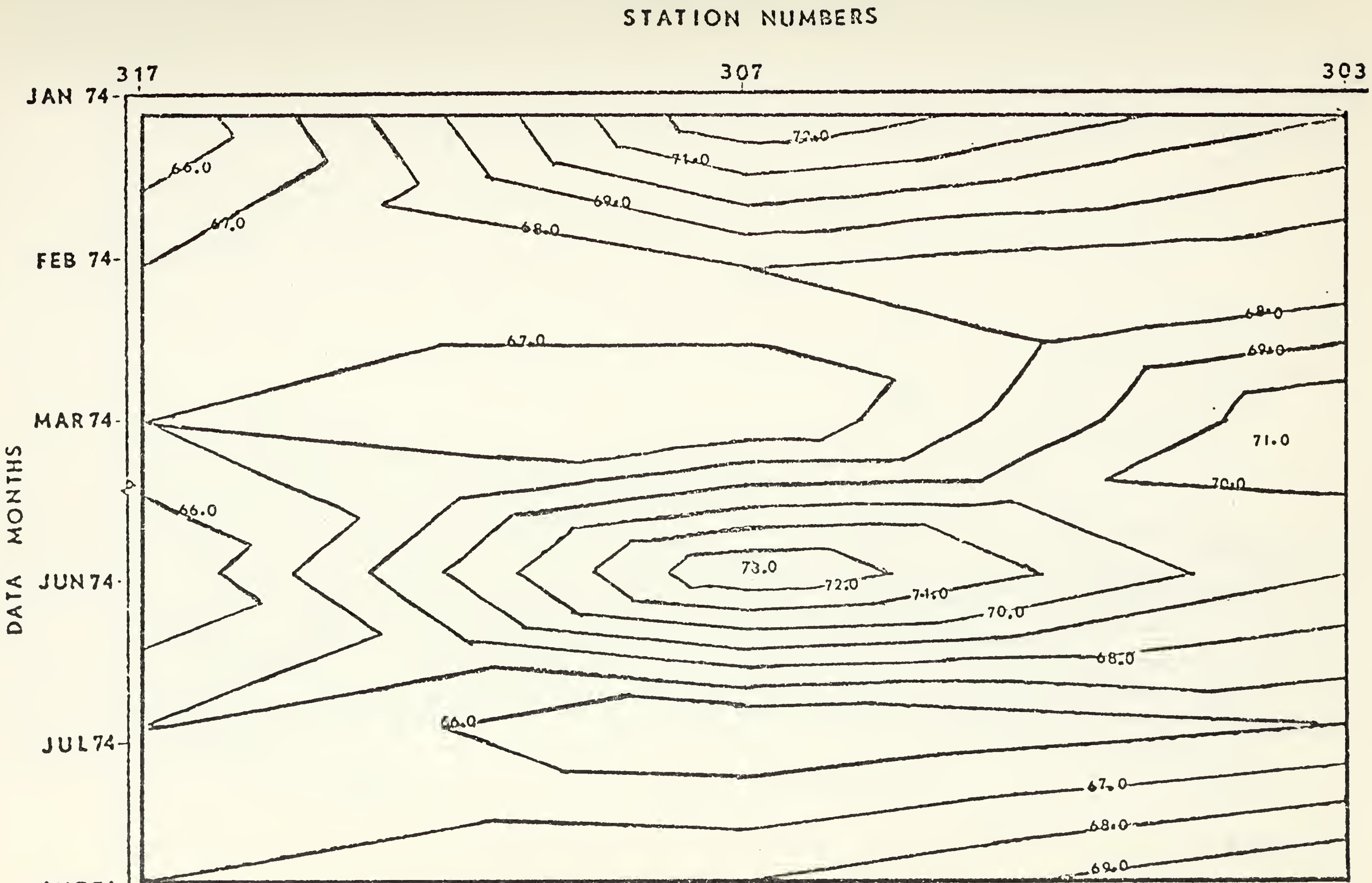


Fig. 18. Temporal Variation of Dynamic Height Contours of the 50 db Surface for January 1974 through August 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

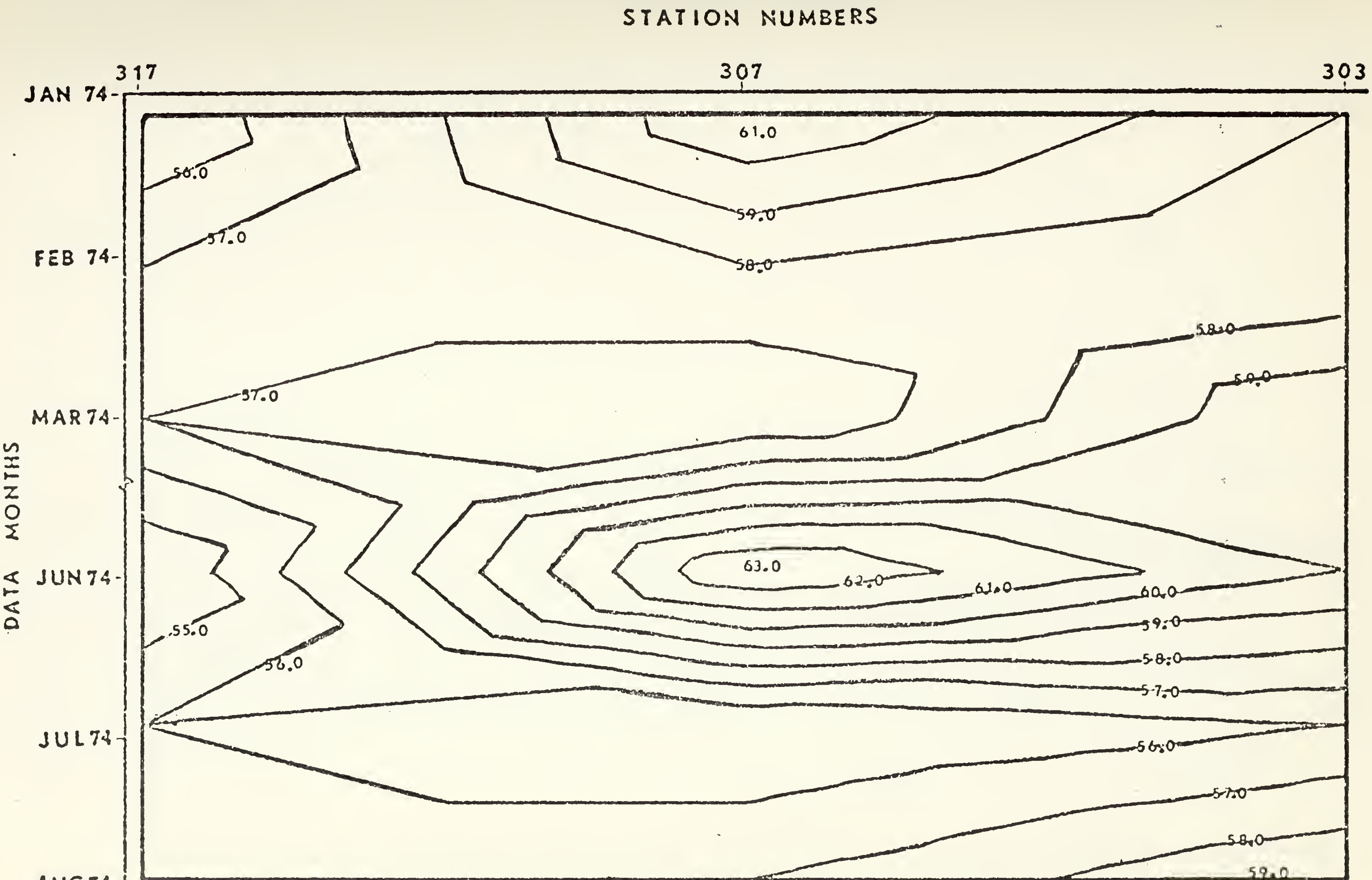


Fig. 19. Temporal Variation of Dynamic Height Contours of the 100 db Surface for January 1974 through August 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

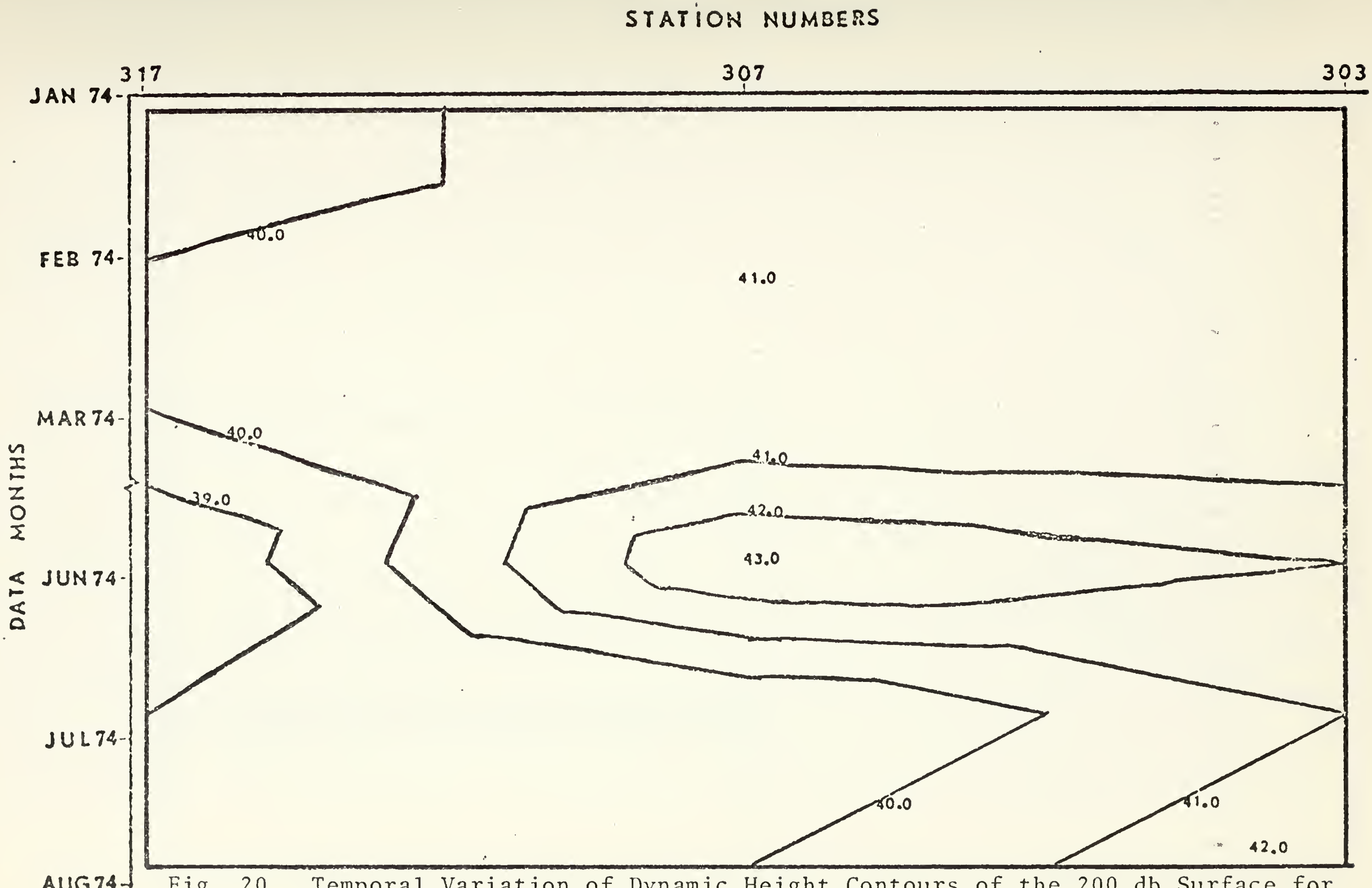


Fig. 20. Temporal Variation of Dynamic Height Contours of the 200 db Surface for January 1974 through August 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

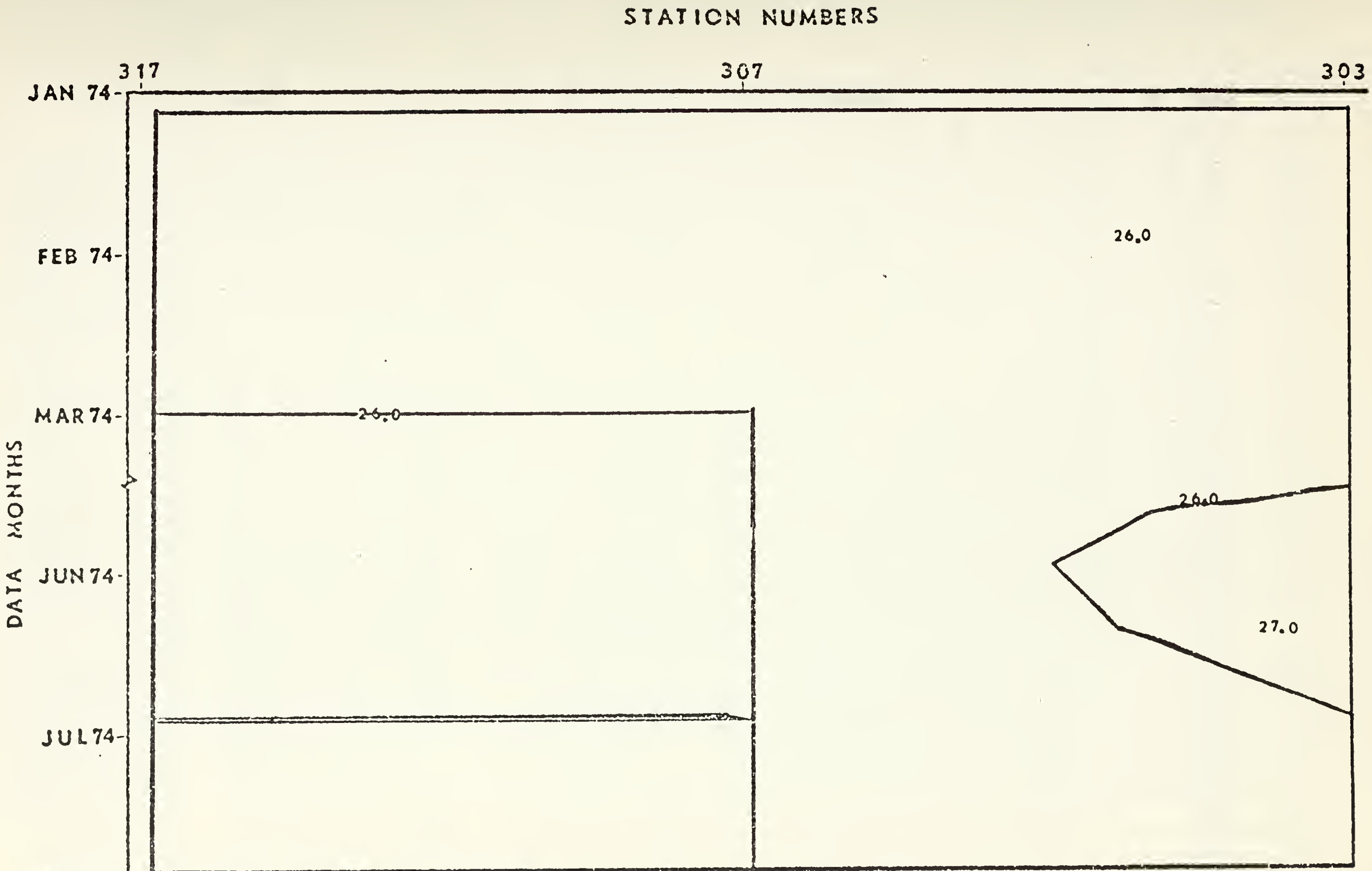


Fig. 21. Temporal Variation of Dynamic Height Contours of the 300 db Surface for January 1974 through August 1974. (Dynamic heights are in dynamic centimeters, relative to 500 db.)

(2) A reversal in flow direction in the upper 200 meters occurs between June and July 1974.

(3) Current speeds at depth during January through August 1974 are significantly less than speeds at depth during August 1973 through January 1974.

D. GEOSTROPHIC CURRENTS AND SALT TRANSPORT

The vertical structure of geostrophic flow normal to a section at latitude 36^{o} 40'N with respect to the 500 db surface is depicted by monthly vertical cross sections of geostrophic salt transport contours. Initially, both vertical cross sections of salt transport contours, and geostrophic isotachs were constructed. However, with exception of magnitude and dimensional units, the isotachs were nearly identical to the vertical contours of geostrophic salt transport. Consequently, the figures depicting vertical cross sections of geostrophic isotachs have been omitted in favor of the salt transport contours. Accordingly, figures 22 through 33 depict the vertical structure of geostrophic salt transport during August 1973 through February 1974, and June through August 1974.

In the discussion and presentation of results in this section, each monthly vertical cross section will be discussed in terms of its general flow and transport characteristics, its direction and current speeds, and the nature of the water.

To clarify the information presented in figures 22 through 33, the following comments are made,

(1) The dimensional units of salt transport are ($gm/sec\text{-}cm^2$).

(2) Generally, every other contour has been labeled according to its particular transport value. Negative values (hatched area) indicate transport to the north, and positive values indicate transport to the south.

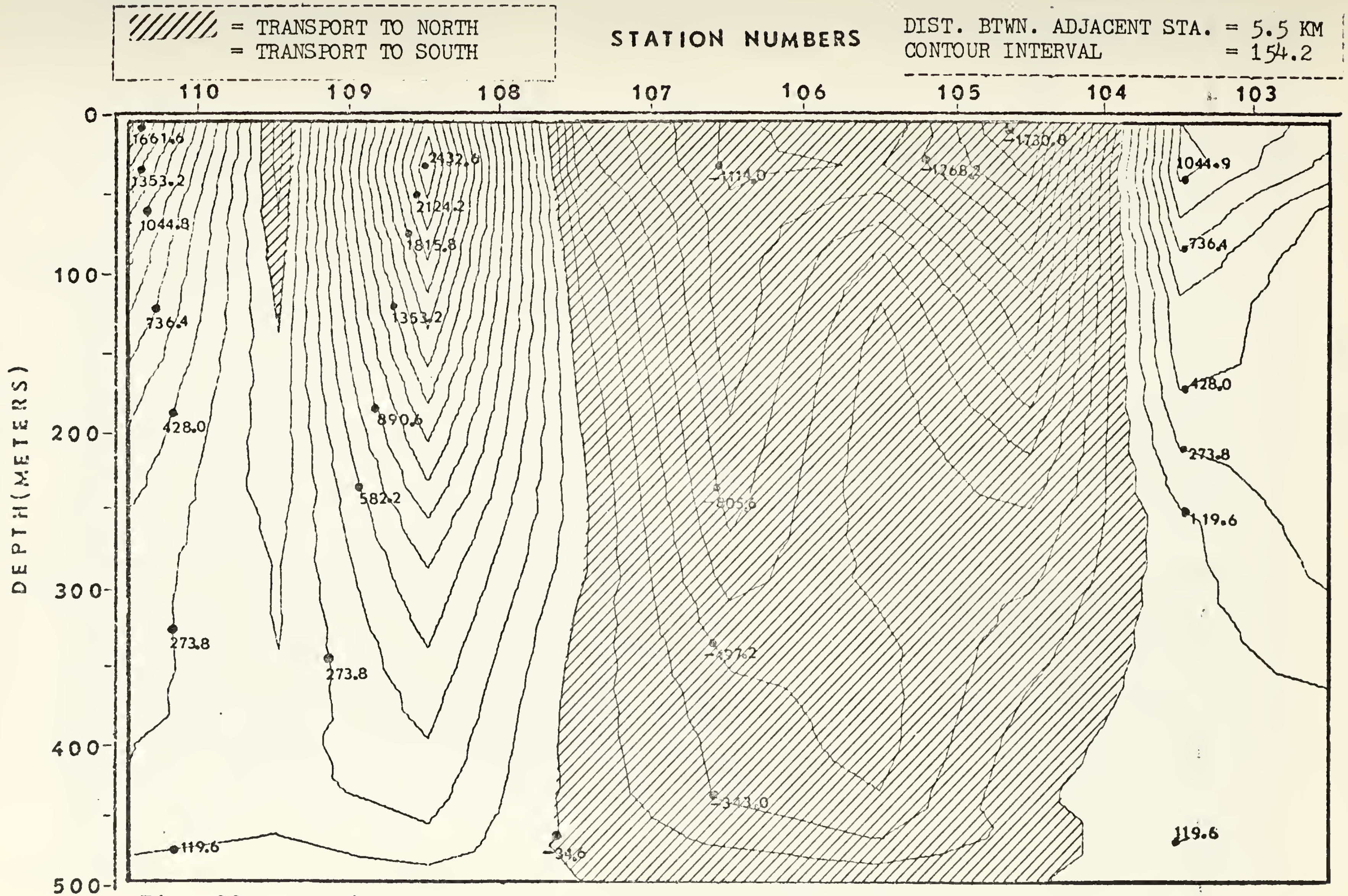


Fig. 22. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 111-102 during August 1973. (Negative transport values (hatched area) in ($gm/sec\text{-}cm^2$) indicate transport to North.)

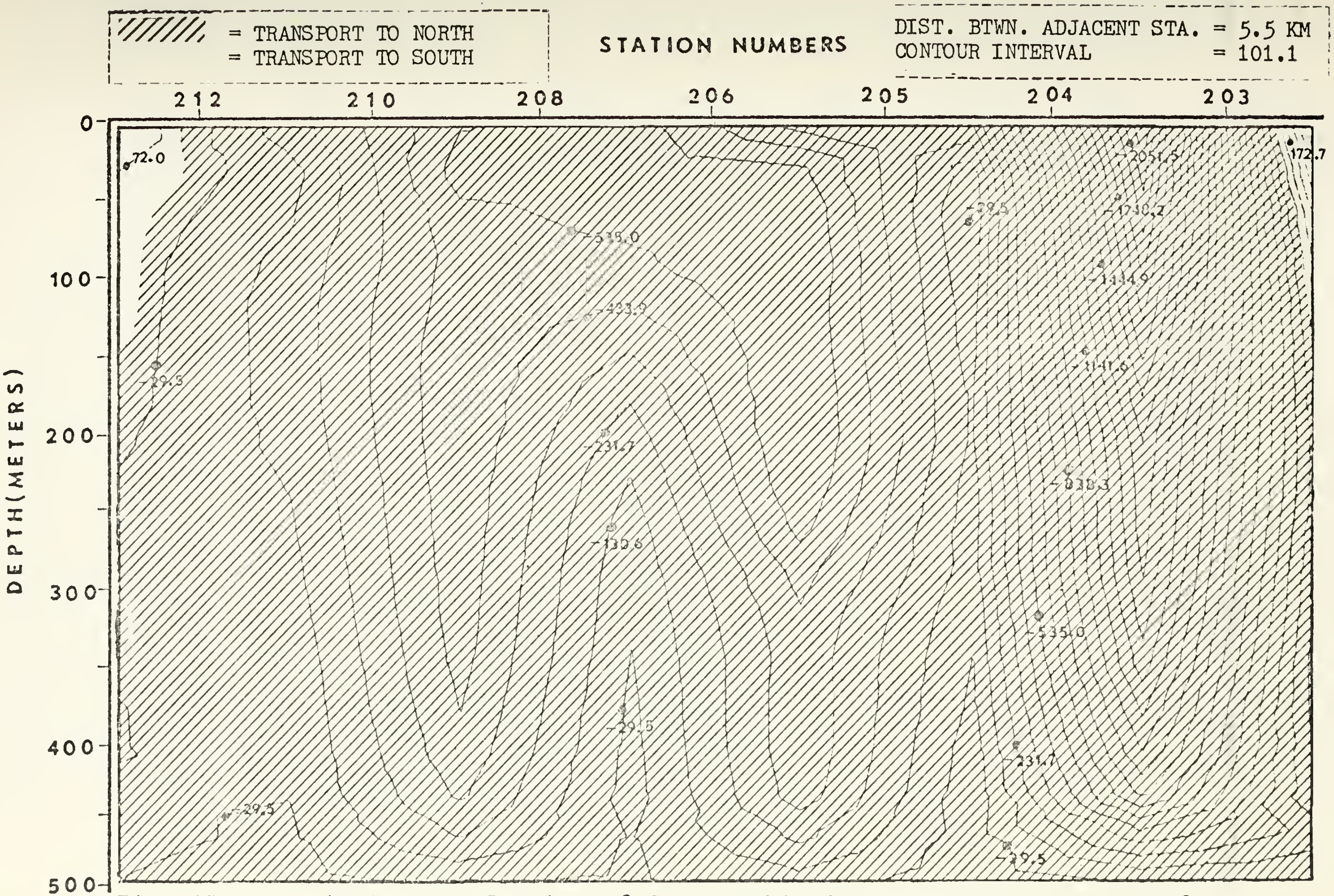


Fig. 23. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 214-202 during August 1973. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

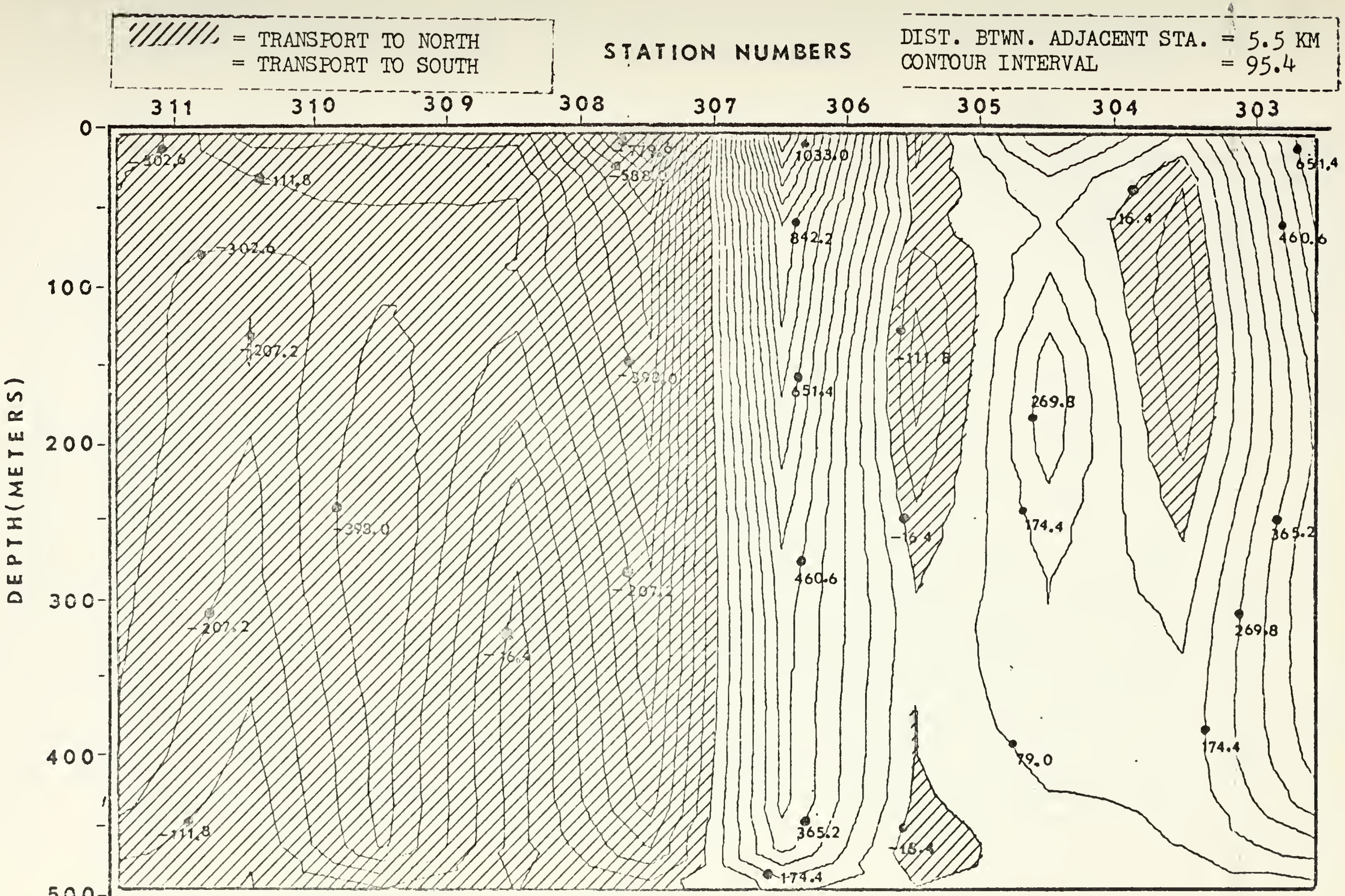
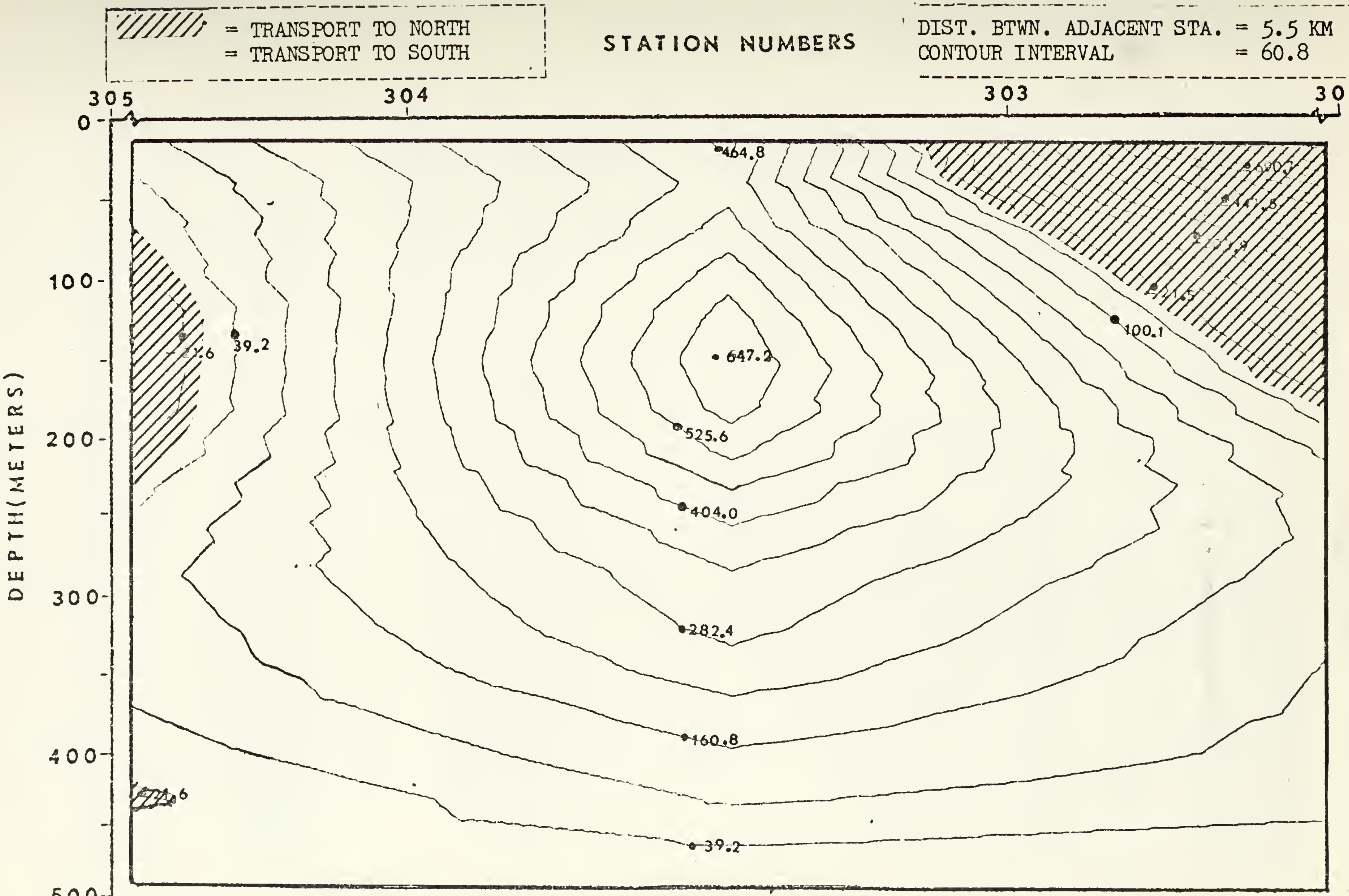


Fig. 24. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 315-302 during August 1973. (Negative transport values (hatched area) in ($gm/sec\text{-}cm^2$) indicate transport to North.)



Feb. 25. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317-302 during September 1973. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

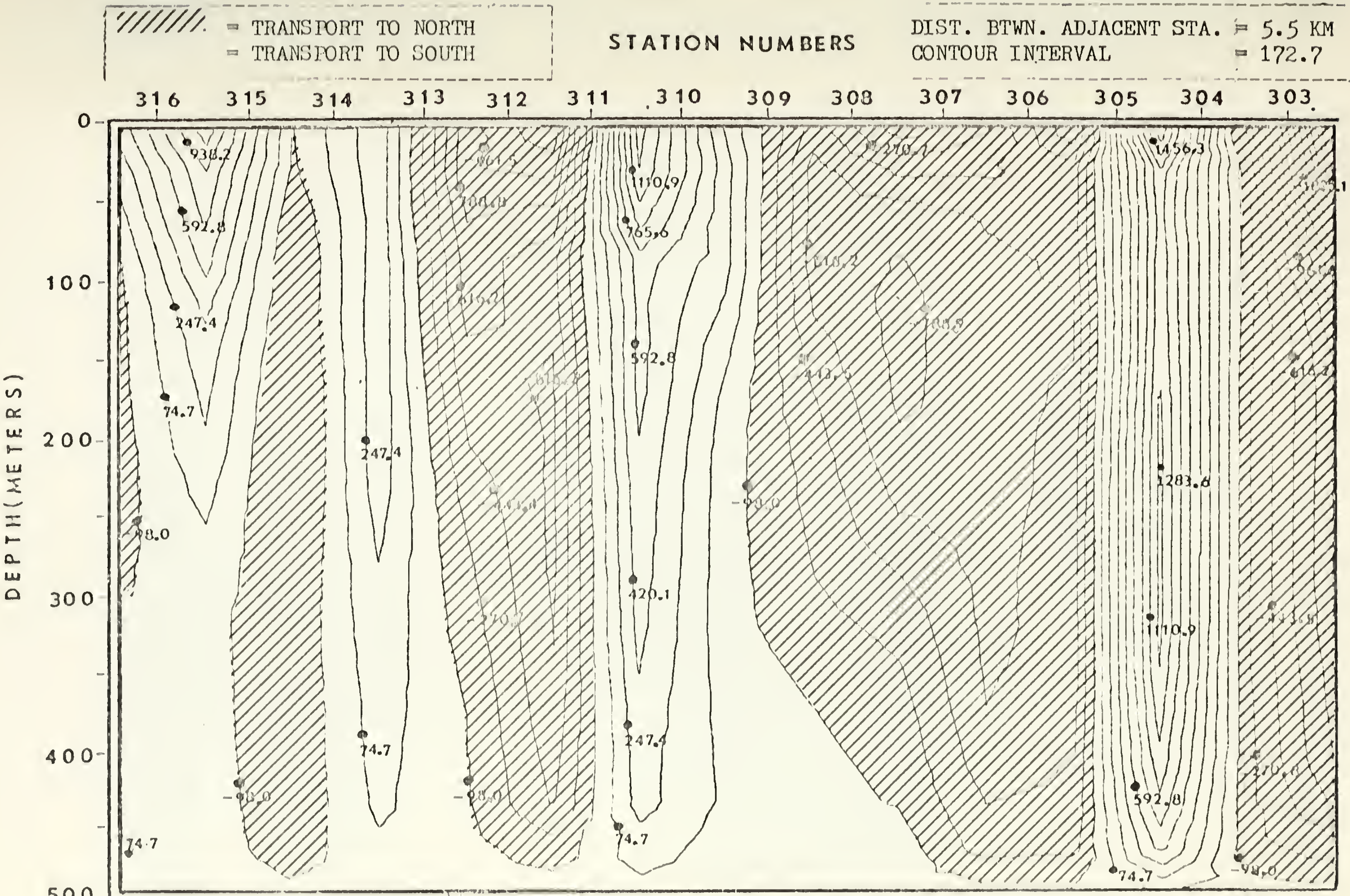


Fig. 26. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317-302 during October 1973. (Negative transport values (hatched area) in (gm/sec-cm²) indicate transport to North.)

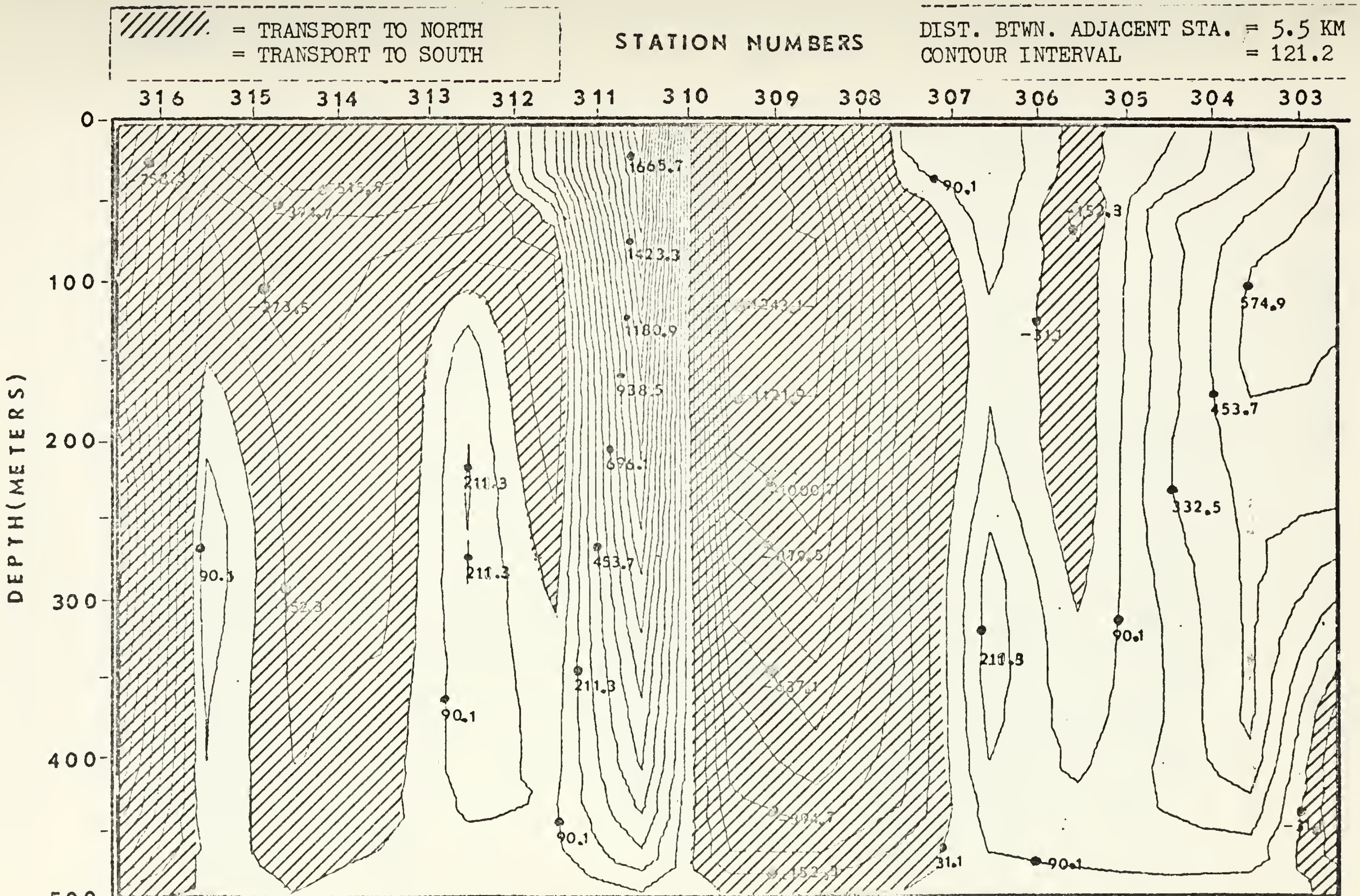


Fig. 27. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317-302 during November 1973. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

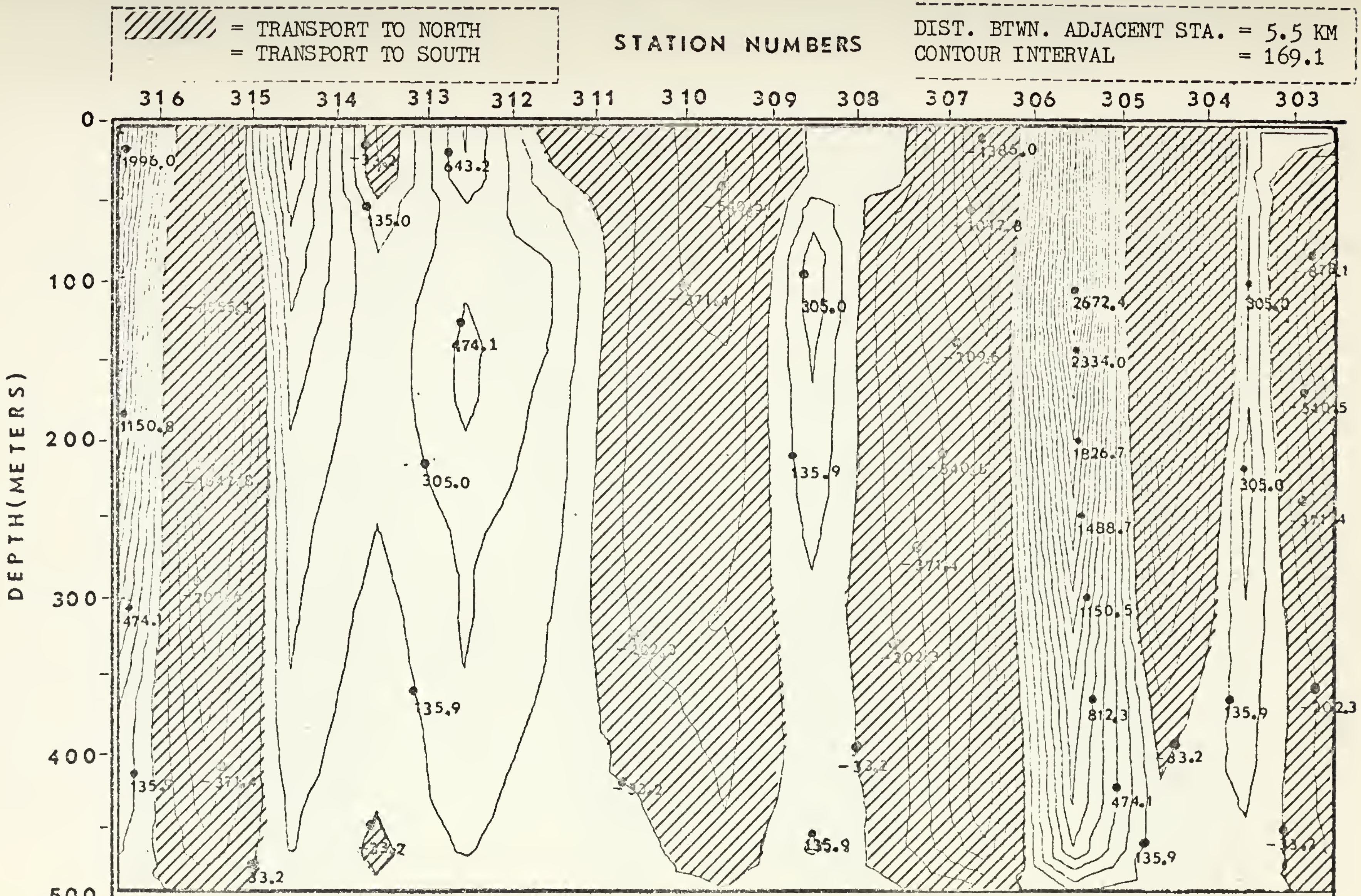


Fig. 28. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317-302 during December 1973. (Negative transport values (hatched area) in (gm/sec-cm²) indicate transport to North.)

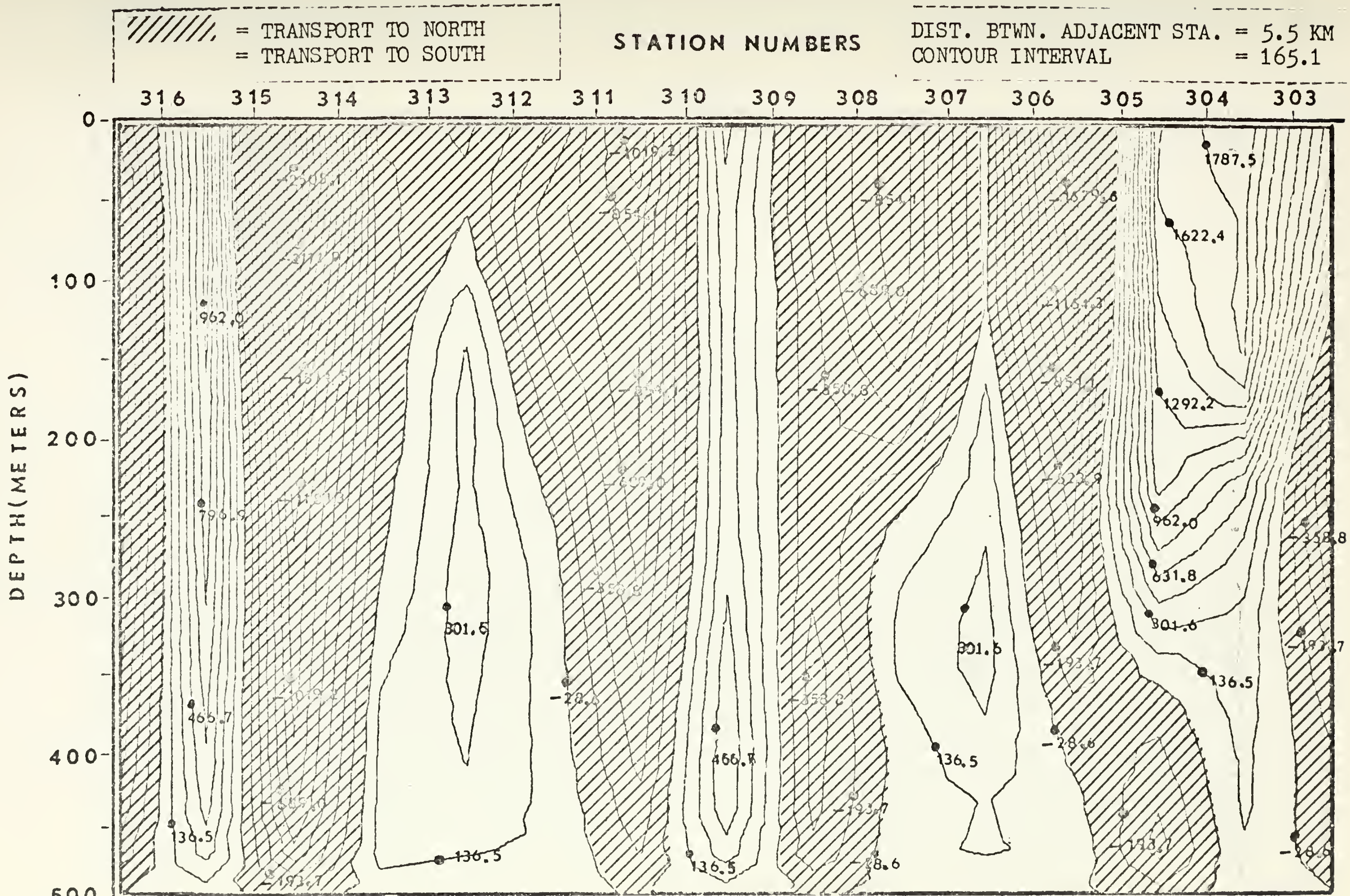


Fig. 29. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317-302 during January 1974. (Negative transport values (hatched area) in (gm/sec-cm²) indicate transport to North.)

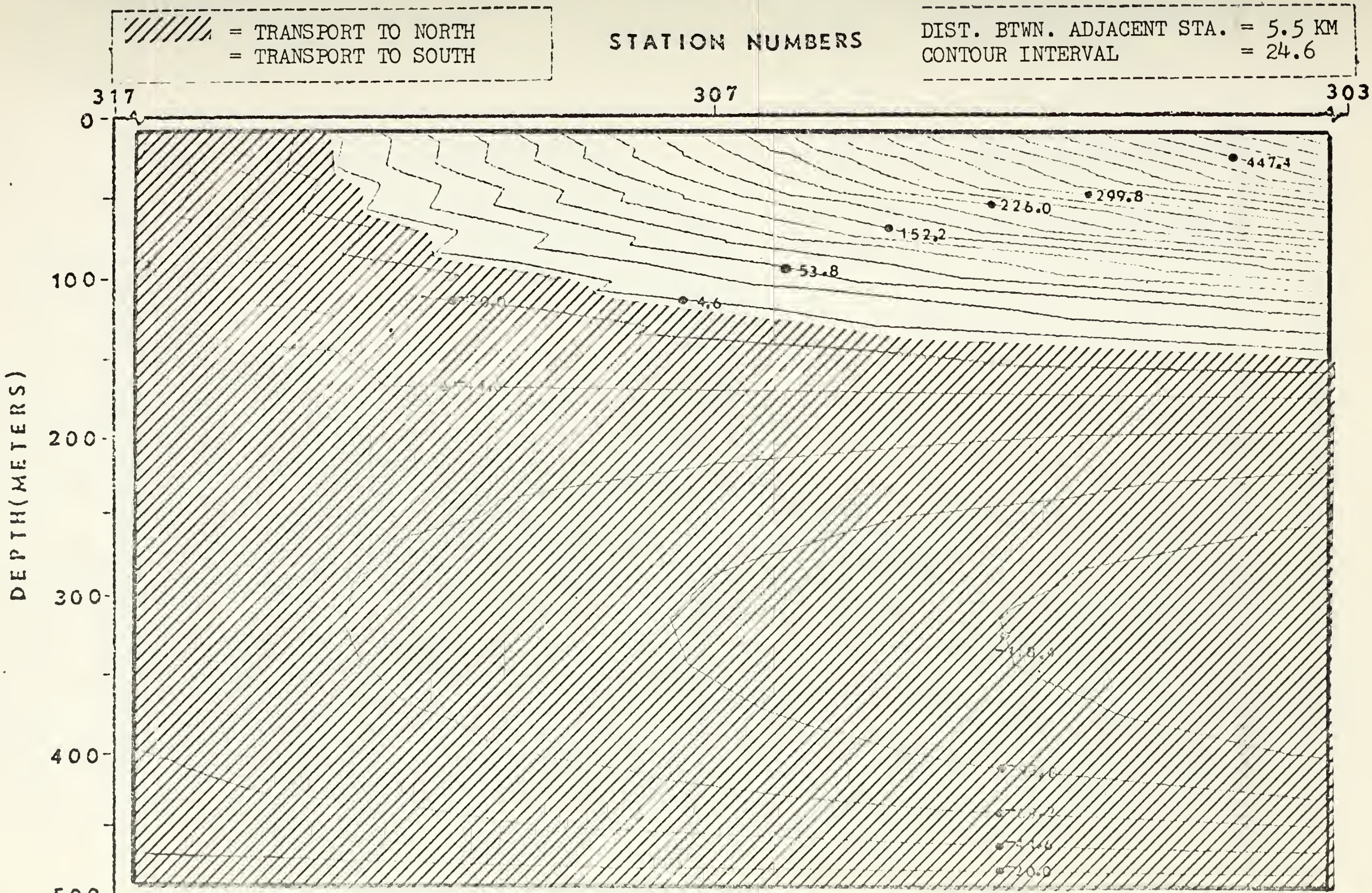


Fig. 30. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317, 307, and 303 during February 1974. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

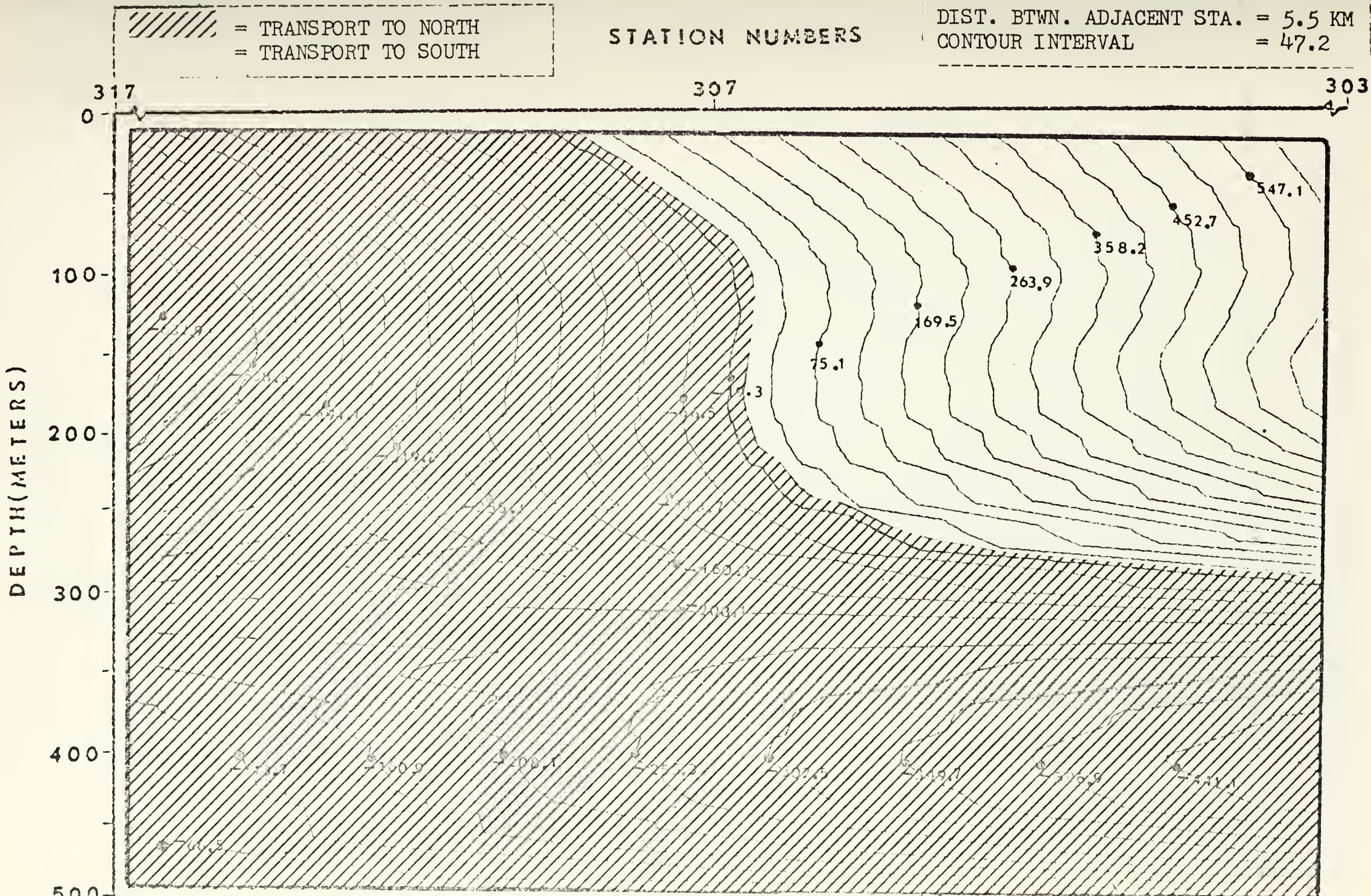


Fig. 31. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317, 307, and 303 during June 1974. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

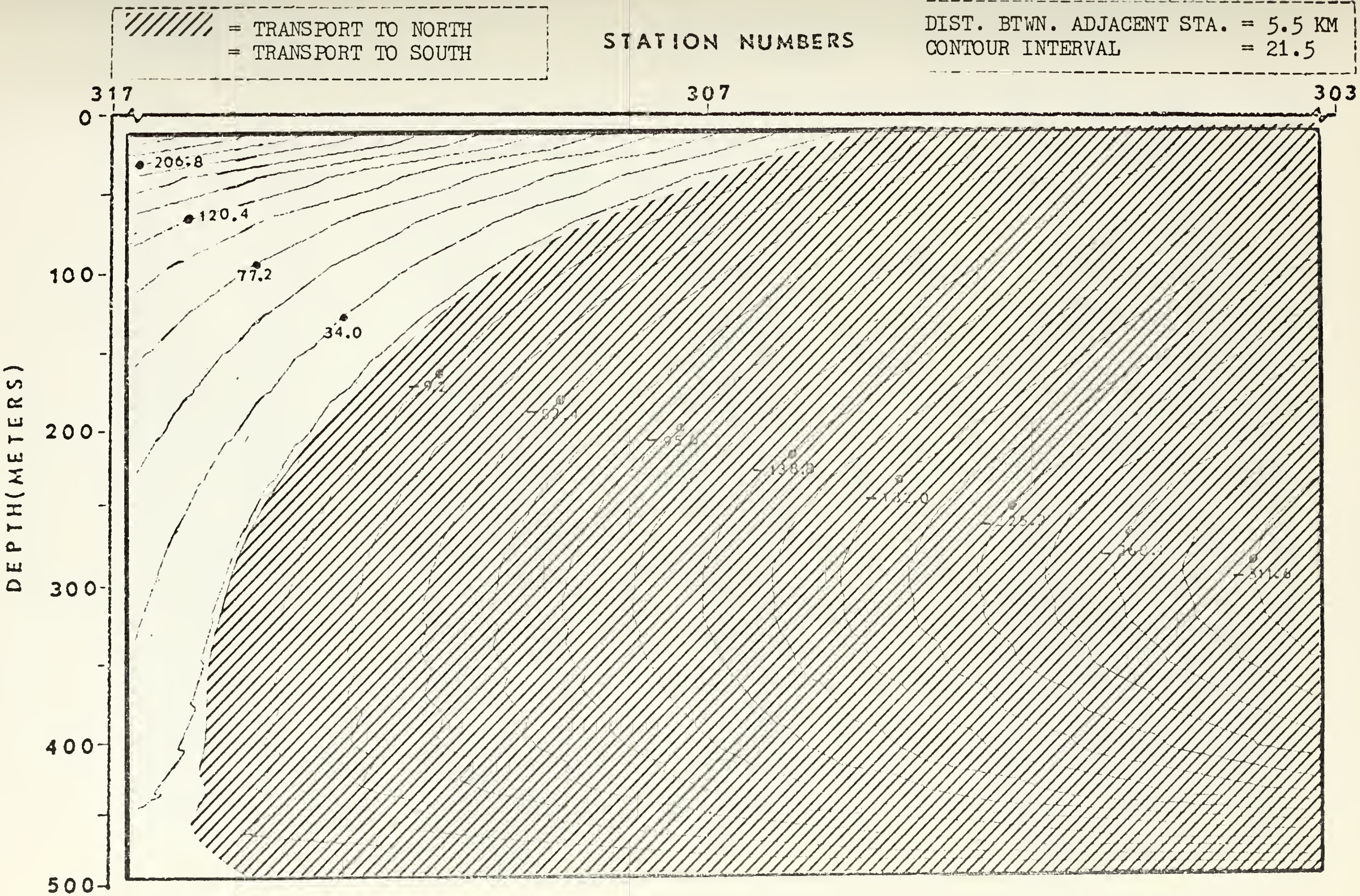


Fig. 32. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317, 307, and 303 during July 1974. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

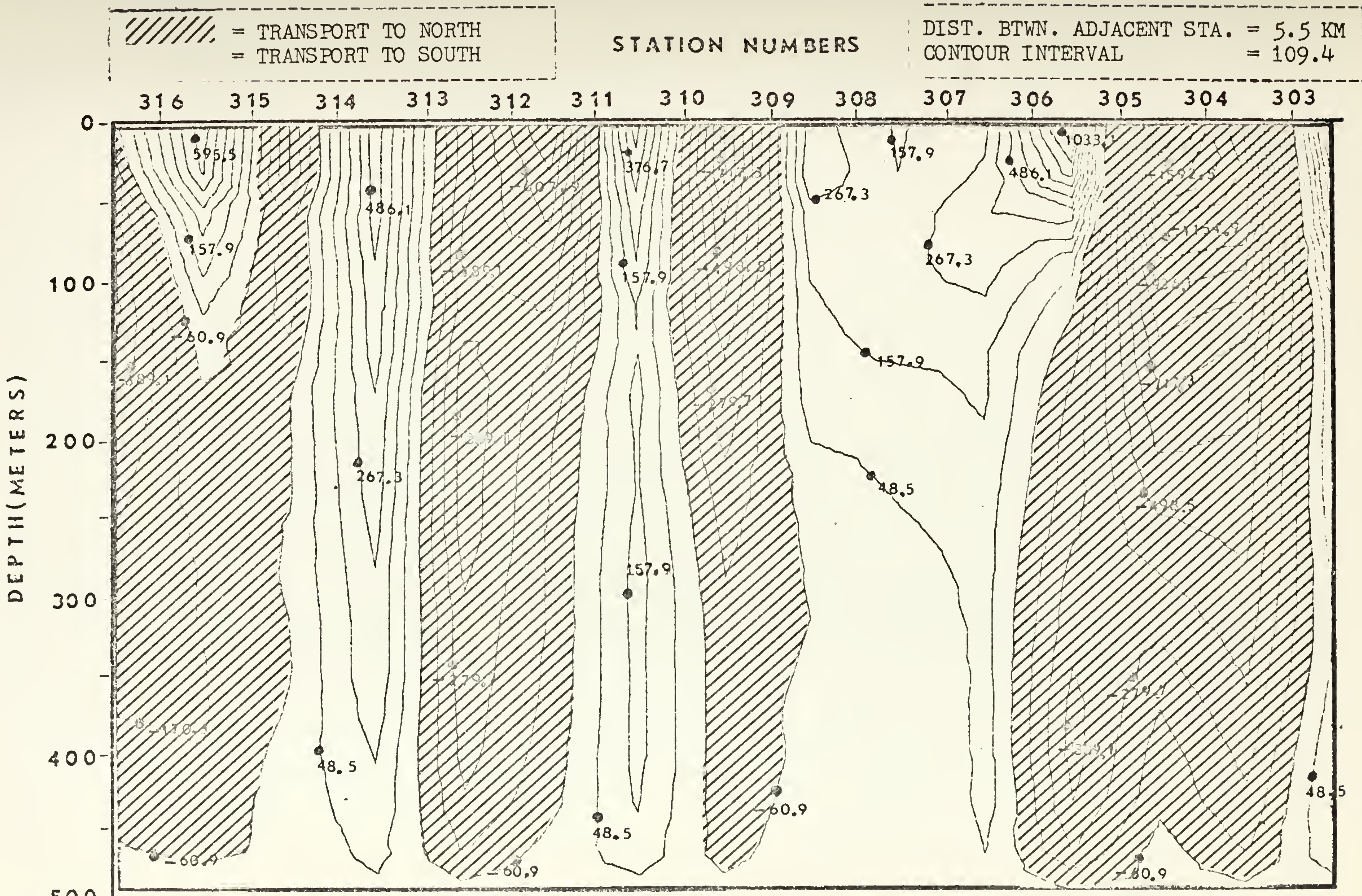


Fig. 33. Vertical Cross Section of Geostrophic Salt Transport Contours for Stations 317-302 during August 1974. (Negative transport values (hatched area) in (gm/sec-cm^2) indicate transport to North.)

(3) The exact contour interval is specified in units, ($gm/sec\text{-}cm^2$), at the upper right-hand corner of each figure.

(4) The black dots adjacent to the individual transport values identify the corresponding contour line.

(5) Distance between consecutively numbered adjacent stations is approximately 5.5 km. Note for figures 30 through 32, the distances between stations 303 and 307, and 307 and 317 are approximately 22 km and 55 km, respectively.

Consider the vertical structure of geostrophic flow during August 1973. Figures 22 through 24 depict the vertical structure of geostrophic salt transport contours during August 1973 for stations 111-102, 214-202 and 315-302, respectively. Examine, first, stations 111-102 along the 36° 20' parallel of latitude depicted in figure 22. Poleward transport (shown by hatched area) located west of longitude 122° 11'W is approximately 20 km in width and extends from the surface to 500 m. A maximum speed and salt transport of approximately 50 cm/sec and 1730 $gm/sec\text{-}cm^2$, respectively, are indicated at the surface between stations 104 and 105. However, current speeds and salt transport values range generally from 30 cm/sec and 1114 $gm/sec\text{-}cm^2$ at the surface to 20 cm/sec and 736 $gm/sec\text{-}cm^2$ at 300 m. To the west of the poleward flow, geostrophy indicates an intense equatorward jet (maximum speed 70 cm/sec) at about longitude 122° 27'W. Farther west the flow is towards the equator with a maximum surface speed of 56 cm/sec decreasing with depth to less than 10 cm/sec at 300 m.

Figure 23 depicts the vertical structure in August 1973 along the 36° 30'N parallel of latitude. Along the entire length of the station line, poleward transport is indicated

by geostrophy with a maximum surface speed of 62 cm/sec decreasing to 15 cm/sec at 300 m in the vicinity of longitude 122° 09'W. Farther to the west the poleward flow is characterized by speed and salt transport surface values of 15 cm/sec and 535.0 gm/sec-cm², respectively.

The vertical structure along the 36° 40'N parallel of latitude during August is depicted by figure 24. East of longitude 122° 22'W the flow is predominantly towards the equator while towards the west the flow is poleward. Maximum current speed and transport surface values are 40 cm/sec and 1320 gm/sec-cm², respectively, towards the equator. While the poleward flow to the west is approximately 35 cm/sec at the surface, it decreases to 10 cm/sec at 300 m.

There is some evidence that the equatorward and poleward jets indicated in figures 22 and 23 are realistic; the author refers to a concurrent study, examining the water mass characteristics by Blumberg [1975]. His findings indicate a sharp front-like water mass boundary along both jet axes. These water mass boundaries are indicated by large angles between isopycnal and isothermal surfaces from the near-surface to approximately 450 m. Additionally, there is theoretical basis for an equatorward jet in a dynamical model for eastern boundary flows [McNider and O'Brien, 1973], and drogue drifts [Wickham, 1975] in the same area also show large shears. These factors tend to support the view that the flow details are real; it should be noted, however, that mass distributions consistent with the calculated dynamic heights could also be produced by internal waves of amplitude 50 m.

Now consider the relation between the flow and structure. The current patterns indicated by both drogues and geostrophy tend to confirm an analysis of the structure which has elongated filaments of southern water flowing poleward in narrow bands, particularly near the coast [Wickham, 1975]. Specifically, drogue paths at 200 m in August 1973 tend to show this tendency.

The vertical structure of geostrophic flow in September 1973 is depicted in figure 25. Unfortunately, only the far eastern sector, stations 302 to 305, of the investigation area is shown. As in the preceding month, the flow in the eastern sector is predominantly to the south. There are maximum speed and salt transports of approximately 20 cm/sec and 650 gm/sec-cm^2 at 150 m. Towards the coastline there is a poleward flow contained in the upper 150 meters with a maximum current speed of 30 cm/sec at the surface.

Figure 26 depicts the vertical structure of geostrophic flow in October 1973. The flow structure consists of elements of several tens of kilometers in width extending from the surface to 500 m. Poleward flow dominates the first 20 km west of station 305, longitude 122° 15'W, with some indications that it is an undercurrent, since a maximum current speed and transport of approximately 20 cm/sec and 790 gm/sec-cm^2, respectively, lie below the surface from 100 to 200 meters. To the west of station 309 the flow appears to be alternating narrow bands of equatorward and poleward flow. The elements are typically 10 km wide, and extend from the surface to 500 m.

The vertical structure of geostrophic flow in November 1973 is depicted in figure 27. The flow is generally poleward

west of station 307 with a maximum salt transport of approximately 1370 gm/sec-cm^2, and current speed of approximately 40 cm/sec at the surface. Upon comparing October and November 1973 vertical cross sections, there are indications that the equatorward flow east of station 307 is becoming weaker with current speeds less than 10 cm/sec at the surface. This is evidence that the onset of the Davidson Current period has taken place. The equatorward jet (maximum speed 55 cm/sec) axis located between stations 310 and 311 (longitude 122^o 33'W) lies in a region with "northern" characteristics; i.e., it is anomalously cold for its density [Blumberg, 1975].

Figure 28 depicts the vertical structure of geostrophic flow in December 1973. The flow is predominantly poleward east of station 311 with the exception of a narrow-banded intense equator jet (maximum speed 77 cm/sec) located between stations 305 and 306 (longitude 122^o 15'W). In this case, the intense equatorward jet axis does not clearly correspond to water of "northern' characteristics. West of station 311 the flow is generally more to the south but weaker than the narrow band of poleward flow. Maximum current speed and salt transport for the narrow band of poleward flow are 30 cm/sec and 1555 gm/sec-cm^2. Whereas, with few exceptions, equatorward current speeds of less than 20 cm/sec characterize the flow within the upper 300 m.

The vertical structure of geostrophic flow in January 1974 is depicted in figure 29. Typical of the Davidson Current period, the general flow is towards the north. Poleward current

speeds vary from approximately 10 to 30 cm/sec in the upper 300 m. Two narrow jets, poleward and equatorward, have axes which are not unambiguously related to the water mass structure. The poleward jet reaches a maximum speed of 75 cm/sec while the equatorward jet reaches a maximum of 58 cm/sec. West of station 306 the flow structure is complex with regions of weak narrow band equatorward flow interspersed among a predominantly poleward flow.

Figure 30 depicts the flow in February 1974. The geostrophic salt transport contours shown in figure 30 as well as figures 31 and 32 are based on data obtained from three Nansen data stations. Consequently, the small-scale detail seen in previous figures is not recognizable. However, the general flow structure between January and February are similar. From concurrent analysis of water mass characteristics during this month there are indications that upwelling has begun along the coast. Figure 30 also tends to corroborate the onset of upwelling in that the poleward California countercurrent has disappeared, for the most part, above 200 m due to the onset of north-northwesterly winds, and is now in evidence as an undercurrent with a maximum current speed (this being a mean over 20 km) of approximately 4 cm/sec at 300 m. The flow above 100 m is predominantly equatorward with a maximum speed and salt transport of approximately 16 cm/sec and 520 gm/sec-cm^2, respectively.

The vertical structure of geostrophic flow in June 1974 is depicted in figure 31. The California undercurrent is well

defined and confined below 200 m in the eastern part of the investigation area during June. Maximum current speed (14 cm/sec) and salt transport (490 gm/sec-cm^2) occur at 400 m. Farther west the undercurrent tends to surface as evidenced by the maximum speed and transport values occurring between 100 and 200 meters.

Figure 32 depicts the vertical flow structure in July 1974. The undercurrent has pushed closer to the coast, and shows signs of its ascent to the surface. The maximum poleward current speed (9 cm/sec) and salt transport (312 gm/sec-cm^2) are located at 300 m. Concurrent analyses of the water mass characteristics indicate that upwelling was not present along the station line at 36° 40'N but was possibly present along the 36° 30'N parallel line. This is not surprising since upwelling tends to be a localized phenomenon. The flow depicted in figure 32 appears to agree with the seasonal period of the California Current System.

The vertical structure of geostrophic flow in August 1974 is depicted in figure 33. The ascending undercurrent depicted in figure 32 has now surfaced with a maximum poleward current speed and salt transport of 53 cm/sec and 1810 gm/sec-cm^2, respectively, at the surface. The major northward flow between stations 303 and 306 coincides with southern water in a separate analysis [Blumberg, 1975]. Typical of the California Current during transition to the oceanic period, the flow is becoming more equatorward. However, west of station 309 the flow is apparently complex and characterized by narrow bands (less than 10 km wide) of weak poleward and equatorward flow.

From figures 22 through 33, it is apparent that the flow and structure in this area of the California Current System are highly complex. The vertical structure, in many cases, is characterized by what appears to be narrow bands of flow less than 10 km in width and by water mass elements of similar scale. Accordingly, only in surveys with sampling grid lengths less than 10 km could the complex structure and flow be realistically depicted. Of course, there still remains the question whether the results depicted here by geostrophy are correct in regards to the small-scale features. However, a sampling grid length of this order in the construction of a data base, in addition to extensive independent measurements of the current system, seems to be required if the behavior of the southern water and its associated current system are to be described.

V. SUMMARY AND CONCLUSIONS

A. GENERAL

The oceanic region just west of the continental shelf off Monterey Bay was examined in detail during the period August 1973 through August 1974. Observations were made on a horizontal grid much finer than is traditionally used in oceanographic surveys in order to permit horizontal definition of narrow bands of flow, and a continuous STD profiler was used to provide high density vertical sampling. Accordingly, the analyses of the data base over the 13-month period provided a description of the mesoscale components of the apparent geostrophic flow and its temporal and spatial variability in the California Current System. Some of the more interesting features of the flow and its structure with depth are provided below.

B. PATTERNS OF CURRENT FLOW AND THEIR STRUCTURE WITH DEPTH

Patterns of current flow inferred from geostrophy with respect to the 500 db surface in August 1973 showed the surface current flow patterns to be similar to those found at depths from the surface to 375 m. The area studied was characterized by narrow bands of interlacing poleward and equatorward flow. Generally, the flow in this area tended to follow bathymetric contours, and there was evidence that the bottom topography influenced the direction of flow within the 1,000 fathom curve. Additionally, independent current flow

measurements made using parachute drogues during August 1972 and August 1973 by Wickham [1975] confirm the general flow patterns inferred from geostrophy.

C. TEMPORAL VARIATION OF THE GEOSTROPHIC FLOW

The variation of the geostrophic flow with time inferred from geostrophy with respect to the 500 db surface showed that the general surface flow patterns over the time period, August 1973 through January 1974, are similar to those found at depths from the surface to 300 m. The geostrophic flow was more intense during the period November 1973 through January 1974 than during August 1973 through October 1973 in the upper 200 m. What appear to be narrow bands of poleward and equatorward flow, which could result from transient effects due to the redistribution of mass by internal waves, characterized the study area. Additionally, the equatorward flow in the eastern sector of the area appeared to be more intense in the upper 200 m during December 1973 and January 1974 than the poleward flow. Finally, the time history showed the poleward flow to shift to the west with time.

The variation of the geostrophic flow with time over the period January 1974 through August 1974 showed the flow to be more intense during January, June and August 1974 than during February, March and July 1974. Additionally, current speeds at depth during January through August 1974 were significantly less than speeds at depth during August 1973 through January 1974. And a reversal in flow direction in the upper 200 m was revealed between June and July 1974.

D. GEOSTROPHIC CURRENT AND SALT TRANSPORT

The vertical structure of geostrophic flow, depicted by monthly vertical cross sections of geostrophic salt transport contours, showed three distinct oceanographic seasons, and were consistent with Skogsberg's [1936] annual cycle of the California Current System. The flow and structure inferred from geostrophy in the area appeared highly complex with interlacing narrow bands (many times less than 10 km in width) of poleward and equatorward flow. Additionally, equatorward and poleward jets (speeds up to 77 cm/sec) were found to have axes corresponding to sharp water mass boundaries indicated by large angles between the isopycnal and isothermal surfaces.

A P P E N D I X   A

```
C TITLE           DIGISTD
C
C
C PRCGRAMMERS     R.E.GREER,R.E.BLUMBERG,AND J.G.HUGHES EXTENSIVELY MODIFIED AN
C                 ORIGINAL PROGRAM,MIZ2, BY R.G.PAQUETTE.
C
C DOCUMENTATION   R.E.GREER
C
C DATE            26 JUNE 1975
C
C PURPOSE         PROGRAM READS,CONVERTS,AND PROCESSES DIGITIZED SALINITY,
C                 TEMPERATURE,AND DEPTH DATA FROM A CALMA DIGITIZER 7-TRACK
C                 TAPE.  DATA ARE COMPUTED AND STORED EVERY 0.01 INCHES OF DEPTH
C                 FOR OUTPUT TO PRINTER,PUNCHED CARD,OR 9-TRACK TAPE.  PROGRAM
C                 CONVERTS DEPTH,TEMPERATURE,SALINITY AND COMPUTES SOUND VELOCITY
C                 AND SIGMA-T FOR EACH INDIVIDUAL OCEANOGRAPHIC STATION AND
C                 PRINTS THE DATA IN A STATION DATA SUMMARY.
C
C SEQUENCE        THE PROGRAM PERFORMS ALL FUNCTIONS IN THE FOLLOWING SEQUENCE
C                 OF OPERATIONS:
C                    (A) INITIALIZES ALL ARRAYS AND VARIABLES.
C                    (B) COMPUTES TABLE OF SALINTIY AND TEMPERATURE SCALE
C                    COMVERSION FACTORS.
C                    (C) SKIPS XXX NUMBER OF RECORDS IF NSKP VARIABLE SET OTHER
C                    THAN ZERO ON CONTROL DATA CARD.
C                    (D) READS PAIR OF DATA CARDS (LABEL AND DAT) FOR RECORD
C                    BEING PROCESSED.
C                    (E) TERMINATES PROGRAM IF ISTOP=1 OR AT THE END OF
C                    PROCESSING THE NN-TH RECORD.
C                    (F) SKIPS UNREADABLE OR BAD RECORDS IF NRCSKP VARIABLE SET
C                    TO INDIVIDUAL RECORD NUMBER.
C                    (G) READS USEABLE DATA RECORD INTO A-ARRAY.
C                    (H) MOVES BYTES OF A-ARRAY INTO 4-BYTE WORDS OF B-ARRAY TO
C                    ALLOW PROCESSING BY STANDARD FORTRAN.
C                    (I) PROCESSES RAW B-ARRAY.
C                       (1) IF HEADER RECORD, PROGRAM DECODES HEADER LABEL AND
C                       COMPARES TO LABEL SUPPLIED BY DATA CARD.
C                       (2) IF TRACER RECORD, PROGRAM ADDS AND STORES CUMULATIVE
C                       SUMS OF X AND Y DISTANCE TRAVEL.
C                    (J) INDEXES THE VALUES OF CUMULATIVE DISTANCE BY INCREASING
C                    DEPTH UNITS; INTERPOLATES TO FILL GAPS IN THE FINAL ARRAY
C                    WHICH MAY OCCUR AT THE POINTS OF SCALE CHANGES IN THE
C                    SEGMENTED RECORD.
C                    (K) INSERTS MANUALLY ENTERED SURFACE AND NEAR SURFACE DATA
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C                               VALUES VIA DATA CARD.
C                               (L) INCREMENTS RECORD COUNT AND REPEATS STEPS (D) THRU (K)
C                               UNTIL ALL RECORDS PROCESSED FOR PARTICULAR STATION.
C                               (M) ADJUSTS ALL FINAL DATA ARRAYS TO THE LENGTH OF THE
C                               SHORTEST.
C                               (O) COMPUTES SOUND VELOCITY.
C                               (P) COMPUTES SIGMA-T.
C                               (Q) COMPUTES CONSECUTIVE RECORD SERIALIZATION FOR TAPE
C                               OUTPUT NUMBERING SCHEME.
C                               (R) CONVERTS LETTER DESIGNATOR MONTH/YEAR CODE,AMONC, TO
C                               REAL *8 MONTH/YEAR.
C                               (S) PRINTS OCEANOGRAPHIC DATA STATION SUMMARY.
C                               (T) WRITES ALL STATION DATA ON TAPE IF TAPE=.TRUE..
C                               (U) PUNCHES ALL STATION DATA ON CARDS SUITABLE FOR THESISII
C                               INPUT IF CARDS=.TRUE..
C                               (V) PUNCHES DEPTH,TEMPERATURE,AND SALINITY ON CARDS
C                               SUITABLE FOR INPUT TO HYDROGRAPHIC PROGRAM IF GCARDS=.TRUE..
C                               (W) INITIALIZES ALL ARRAYS AND VARIABLES FOR PROCESSING
C                               NEXT STATION DATA.
C                               (X) REPEATS STEPS (D) THRU (W) UNTIL ALL RECORDS PROCESSED,
C                               ISTOP=1, OR DESIRED RECORD READ.
C
C FEATURES                   PROGRAM CONSISTS OF MANY MARKED PROPERTIES WHICH MAKE IT A
C                            HIGHLY VERSATILE PROGRAM FOR PROCESSING OCEANOGRAPHIC DATA
C                            FROM TAPE. SOME OF THESE PROPERTIES ARE LISTED UNDER THE
C                            FOLLOWING SIX GENERAL CATEGORIES:
C                               (A) INPUT
C                                  (1) 7-TRACK CALMA DIGITIZER TAPE IN BCD.
C                                  (2) TWO DATA CARDS REQUIRED PER TRACE SEGMENT OR HEADER
C                                  LABEL RECORD. EXAMPLE:  AN STD TEMPERATURE TRACE
C                                  CONSISTING OF FOUR SEGMENTS OR RECORDS WILL REQUIRE FOUR
C                                  PAIRS OF DATA CARDS.
C                               (B) SUBROUTINES
C                                  (1) TPRD-  AN ASSEMBLER LANGUAGE SUBROUTINE FOR READING
C                                  MAGNETIC TAPE WHICH CANNOT BE READ BY STANDARD METHODS.
C                                  NOTE: TPRD ALLOWS USER TO SKIP BAD RECORDS WHILE TAPRD
C                                  (W.R.CHURCH COMPUTER CENTER SUBROUTINE) DOES NOT.
C                                  (2) CHMOVE-  MOVES BYTES OF A-ARRAY INTO FOUR BYTE WORDS
C                                  OF B-ARRAY TO ALLOW PROCESSING BY STANDARD FORTRAN.
C                                  (3) CONDNS-  CONDENSES,INDEXES,AND CONVERTS THE
C                                  CUMULATIVE DISTANCE X AND Y ARRAYS,BY INCREASING DEPTH
C                                  UNITS,TO TEMPERATURE AND DEPTH OR SALINITY AND DEPTH.
C                                  (4) OUT1-  PRINTS OCEANOGRAPHIC STATION DATA SUMMARY.
C                                  (5) SVEL-  COMPUTES SOUND VELOCITY FROM DEPTH,TEMPERATURE
C                                  AND SALINITY ACCORDING TO WILSON'S EQUATION.
C                                  (6) SIGMT-  COMPUTES SIGMA-T FROM TEMPERATURE AND
C                                  SALINITY ACCORDING TO H.O.614 P.91.
C                               (C) AUTOMATIC DATA PROCESSING/HANDLING
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```
C                         (1) APPLICABLE TO MULTIPLE DEPTH,TEMPERATURE AND SALINITY
C                         SCALES.
C                         (2) HANDLES OPERATOR MISTAKES MADE IN TRACING STD CURVES
C                         ON CALMA DIGITIZER.
C                         (3) SKIPS AN INITIAL NUMBER OF RECORDS SPECIFIED BY NSKP
C                         AND INDIVIDUAL RECORDS(EVEN IF UNREADABLE) SPECIFIED BY
C                         THE ARRAY NRCSKP.
C                         (4) DECODES 7-TRACK TAPE HEADER LABELS AND TRACE RECORDS.
C                         (5) COMPUTES DATA FOR EVERY 0.01 INCHES DEPTH BUT
C                         SELECTABLE FOR GREATER DEPTH INTERVAL.
C                         (6) ENTERS HAND-ENTERED DATA FOR SURFACE AND NEAR-SURFACE
C                         VALUES.
C                         (7) EDITS OUT ANY UNFILLED ARRAY POSITIONS.
C                         (8) COMPUTES CONSECUTIVE RECORD SERIALIZATION FOR TAPE
C                         OUTPUT NUMBERING SCHEME.
C                         (9) COMPUTES SOUND VELOCITY AND SIGMA-T.
C                      (D) DIAGNOSTICS
C                         (1) WRITES FIRST TWENTY-FIVE VALUES OF B-ARRAY FOR
C                         INSPECTION PURPOSES.
C                         (2) WRITES EVERY TWENTIETH VALUE OF STD ARRAYS FOR
C                         DATA INSPECTION PURPOSES.
C                         (3) WRITES PROGRAM STATEMENT NUMBER IN ADDITION TO
C                         MESSAGE WHEN SIGNIFICANT OPERATIONS OCCUR.
C                      (E) TROUBLE-SHOOTING
C                         (1) HANDLES MULTIPLE KEYBOARD AND TRACER SYMBOL ENTRIES.
C                         (2) PROVIDES FOR A MISSED HEADER LABEL OR INCOMPLETE
C                         HEADER LABEL.
C                         (3) HANDLES MISSING INTER-RECORD GAPS.
C                         (4) HANDLES DELETE RECORD BY INCREMENTING RECORD COUNT
C                         AND READING SAME PAIR OF DATA CARDS AGAIN.
C                         (5) COMPARES CARD HEADER LABEL AGAINST TAPE HEADER LABEL
C                         AND ACCEPTS CARD VALUES IF CARD AND TAPE DISAGREE.
C                      (F) OUTPUT
C                         (1) PRINTER-  TWO PRINTING VARIABLES,PRT1 AND PRT2.
C                            (A) OCEANOGRAPHIC DATA STATION SUMMARIES.
C                            (B) PRT2, PROVISION ONLY.
C                         (2) CARD-  TWO CARD PUNCHING ROUTINES,CARDS AND GCARDS.
C                            (A) PUNCHED DATA CARDS SUITABLE FOR USE WITH THESISII.
C                            (B) PUNCHED DATA CARDS FOR INPUT TO HYDROGRAPHIC
C                            PROGRAM.
C                         (3) TAPE-  9-TRACK TAPE
C                         (4) PLOTTING-  PROVISIONS FOR PLOTTING ROUTINES ACTUATED
C                         BY PLT1 AND PLT2 ARE NOT PRESENTLY PROGRAMMED.
C
C ARGUMENTS            PROGRAM CONSISTS OF MANY TERMS,ARRAYS AND VARIABLES.  THE
C                      FOLLOWING IS A BRIEF DESCRIPTION OF THE IMPORTANT ARGUMENTS
C                      LISTED ALPHABETICALLY UNDER TWO GENERAL CATEGORIES.
C                         (A) ARRAYS
```

```
C              (1) D,T,S,D2,T2,S2   = DEPH,TEMPERATURE AND SALINITY
C              (2) DH,TH,SH         = HAND-ENTERED SURFACE AND NEAR
C                                   SURFACE DATA VALUES.
C              (3) X,Y              = CUMULATIVE SUMS OF DISTANCE AND
C                                   DEPTH TRAVEL.
C              (4) NRCSKP           = NUMBER OF INDIVIDUAL RECORD SKIPPED
C              (5) DCON             = DEPTH CONVERSION FACTOR.
C              (6) CORRS,CORRT      = ADDITIVE CORRECTIONS TO SALINITY
C                                   AND TEMPERATURE ASSOCIATED WITH STD
C                                   SCALE CHANGES.
C              (7) IREC             = CONSECUTIVE SERIAL RECORD NUMBER.
C              (8) AMONCA           = MONTH/YEAR CODE LETTER.
C              (9) EVENT            = MONTH AND YEAR.
C           (B) TERMS
C              (1) CARDS            = VARIABLE PERMITS PUNCHING CARDS.
C              (2) CONTRL           = NAMELIST VARIABLE USED FOR
C                                   INFREQUENTLY CHANGED VARIABLES.
C              (3) CORD             = DEPTH CORRECTION TERM.
C              (4) DAT              = NAMELIST VARIABLE USED FOR
C                                   FREQUENTLY CHANGED VARIABLES.
C              (5) DLTREC           = DELETE RECORD
C              (6) FLAG             = INDICATES START OF DATA TRACE.
C              (7) GCARDS           = VARIABLE PERMITS PUNCHING CARDS FOR
C                                   HYDROGRAPHIC PROGRAM INPUT.
C              (8) GCRD             = NUMBER OF HYDROGRAPHIC CARDS TO BE
C                                   PUNCHED.
C              (9) ICODE            = VARIABLE USED TO IDENTIFY EITHER
C                                   TEMPERATURE OR SALINITY TRACE RECORD.
C              (10) ICSQZ           = VARIABLE USED TO COMPRESS NUMBER
C                                   OF DATA VALUES OUTPUT TO CARDS
C                                   PUNCHING ROUTINE.
C              (11) IGSQZ           = VARIABLE USED TO COMPRESS NUMBER
C                                   OF DATA VALUES OUTPUT TO GCARDS
C                                   PUNCHING ROUTINE.
C              (12) ISQZ            = VARIABLE USED TO COMPRESS NUMBER
C                                   OF DATA VALUES OUTPUT TO PRINTER.
C              (13) IDEPTH          = VARIABLE USED TO IDENTIFY HEADER
C                                   LABEL OR TRACE RECORD.
C              (14) ISCL            = THE SCALE NUMBER ON THE STD
C                                   SALINITY SCALE DIAL.
C              (15) ITSCL           = THE SCALE NUMBER ON THE STD
C                                   TEMPERATURE SCALE DIAL.
C              (16) IDSCL           = THE SCALE NUMBER ON THE STD DEPTH
C                                   SCALE DIAL.
C              (17) ISTA            = VARIABLE IDENTIFIES STATION NUMBER.
C              (18) IP              = WHEN SET EQUAL TO 1 ON &DAT, IP IS
C                                   A PRINT COMMAND TO CAUSE DATA TO BE
C                                   OUTPUT AND VARIABLES INITIALIZED FOR
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C                                          THE NEXT STATION.
C                          (19) IH         = NUMBER OF HAND-ENTERED SURFACE OR
C                                          NEAR-SURFACE DATA VALUES.
C                          (20) IHDR       = WHEN SET EQUAL TO 1 PERMITS
C                                          ENTERING MISSING OR FAULTY DIGITIZER
C                                          TAPE HEADER INFO VIA DATA CARD.
C                          (21) ISTOP      = TERMINATES PROGRAM IF SET EQUAL TO
C                                          1 ON A FINAL &DAT CARD PRECEDED BY
C                                          A LABEL CARD.
C                          (22) JREC       = VARIABLE USED TO COUNT RECORDS FOR
C                                          RECORD SERIALIZATION PURPOSES.
C                          (23) JSKIP      = WHEN SET EQUAL TO 1 ON THE LABEL
C                                          CARD, CAUSES THE PROGRAM TO ACCEPT
C                                          DATA ON AN &CONTRL CARD.
C                          (24) KEY        = THE KEYBOARD SYMBOL ON THE
C                                          DIGITIZER TAPE.
C                          (25) KCRD       = NUMBER OF DATA POINTS TO BE PUNCHED
C                                          BY CARDS PUNCHING ROUTINE.
C                          (26) KDTA       = NUMBER OF RECORDS PROCESSED FOR
C                                          PARTICULAR STATION.
C                          (27) LABEL      = HEADER TYPE DATA CARD WHICH
C                                          IDENTIFIES STATION NUMBER AND TYPE
C                                          TRACE, TEMPERATURE OR SALINITY.
C                          (28) NCRDS      = NUMBER OF CARDS PUNCHED BY CARDS
C                                          PUNCHING ROUTINE.
C                          (29) NE         = THE INDEX AT THE LAST USEFUL ARRAY
C                                          POSITION OF THE X(DEPTH) ARRAY.
C                          (30) NOIRG      = VARIABLE USED TO INDICATE MISSING
C                                          END OF RECORD GAP ON TAPE.
C                          (31) NSKP       = NUMBER OF INITIAL RECORDS ON TAPE
C                                          SKIPPED.
C                          (32) SCON       = SALINITY SCALE CONSTANT.
C                          (33) SCOR       = CORRECTION FACTOR ADDED TO SALINITY
C                                          DATA VALUES.
C                          (34) TCON       = TEMPERATURE SCALE CONSTANT.
C                          (35) TCOR       = CORRECTION FACTOR ADDED TO
C                                          TEMPERATURE DATA VALUES.
C                          (36) WMONTH     = MONTH AND YEAR
C
C
C DATA DECK        THE FOLLOWING IS A SAMPLE DATA DECK REQUIRED BY THIS
C                  PROGRAM. SAMPLE BELOW SHOWS DATA CARDS REQUIRED FOR TWO
C                  STATIONS, 3070 AND 3080. ALSO SHOWN IS 'STATION END' CARD
C                  WTIH ISTOP SET EQUAL TO ONE.
C
 &CONTRL NN=400,TAPE=F,CARDS=F,GCARDS=F,ISQZ=01,NSKP=90,NRCSKP=103,104,105,
 106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,
 124,125,126,175,176,177,178,179,180,181,182,183,184,185,186,ICSQZ=8,
```

```
IGSQZ=8,TCOR=-0.08,SCOR=0.04,&END
    UCM004    INCLUDES STATIONS  3070 THRU 302R MINUS 3080,3090 AND 3140.
STATION 3070 TEMPERATURE HEADER                                          0
&DAT ISTA=307,AMONC='0',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,
DH=0.0,TH=11.24,SH=33.40,IH=1,&END
STATION 3070 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3070 TEMPERATURE HEADER                                          0
&DAT IDEPTH=99,ITSCL=3&END
STATION 3070 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3070 TEMPERATURE HEADER                                          0
&DAT IDEPTH=99,IDSCL=2&END
STATION 3070 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3070 TEMPERATURE HEADER                                          0
&DAT IDEPTH=99,ITSCL=2&END
STATION 3070 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3070 SALINITY HEADER                                             0
&DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
STATION 3070 SALINITY TRACE                                              0
&DAT  IDEPTH=00&END
STATION 3070 SALINITY HEADER                                             0
&DAT IDSCL=2,IDEPTH=99,IP=1,&END
STATION 3070 SALINITY TRACE                                              0
&DAT  IDEPTH=00&END
STATION 3080 TEMPERATURE HEADER                                          0
&DAT ISTA=308,AMONC='0',IDEPTH=99,IDSCL=1,ICODE=0,ITSCL=4,ISCL=3,IP=0,&END
STATION 3080 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3080 TEMPERATURE HEADER                                          0
&DAT IDEPTH=99,ITSCL=3,&END
STATION 3080 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3080 TEMPERATURE HEADER                                          0
&DAT IDEPTH=99,IDSCL=2&END
STATION 3080 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3080 TEMPERATURE HEADER                                          0
&DAT IDEPTH=99,ITSCL=2&END
STATION 3080 TEMPERATURE TRACE
&DAT  IDEPTH=00&END
STATION 3080 SALINITY HEADER                                             0
&DAT IDSCL=1,IDEPTH=99,ICODE=1,ITSCL=4,&END
STATION 3080 SALINITY TRACE                                              0
&DAT  IDEPTH=00&END
STATION 3080 SALINITY HEADER                                             0
```

```
 &DAT IDSCL=2,IDEPTH=99,IP=1,&END
 STATION 3080 SALINITY TRACE                                         0
 &DAT  IDEPTH=00&END
 STATION END                                                         1
C (END OF FILE)
C
C
C DECK SET-UP    THE FOLLOWING IS AN EXAMPLE OF JOB CONTROL LANGUAGE
C                AND DECK SET-UP REQUIRED TO USE DIGISTD. THIS
C                PARTICULAR DECK SET-UP WAS USED TO WRITE FILE 6 ON
C                9-TRACK TAPE, NPS-527. THE 9-TRACK TAPE WAS WRITTEN AT
C                800 BPI WITH A LRECL OF 40 AND BLKSIZE OF 32,520.
C                HINDSIGHT INDICATES THAT IT IS DESIRABLE TO WRITE
C                THE TAPE AT A BLKSIZE OF 8000 VICE 32,520 SINCE IT IS
C                EXTREMELY ADVANTAGEOUS TO KEEP FOLLOW ON TAPE
C                PROCESSING PROGRAMS SMALL (IE LESS THAN 100K).
C
C
//GUCMSTD6 JOB (2006,0823,0S42),' RE GREER SMC 1413',TIME=10,
//     TYPRUN=HOLD,
//     MSGCLASS=O
// EXEC FORTCLG,REGION.FORT=150K,REGION.GO=350K,DEST=O
//FORT.SYSIN DD *
C       ( MAIN SOURCE DECK AND SUBROUTINES)
//GO.FT06F001 DD SPACE=(CYL,(40,03)),SYSOUT=O
//GO.FT07F001 DD DUMMY
//GO.FT08F001 DD UNIT=3400-4,VOL=SER=NPS527,LABEL=(06,SL,,OUT),
//  DISP=(NEW,KEEP),DCB=(DEN=2,RECFM=FB,LRECL=40,BLKSIZE=32520),
//  DSN=S2006.UCM7374
//GO.METTAP DD UNIT=2400-1,VOL=SER=UCM004,DISP=OLD,LABEL=(,NL),
//       DCB=(DEN=1,TRTCH=ET)
//GO.SYSIN DD *
C       (DATA DECK)
C (END OF FILE)
```

```
C
C MAIN PROGRAM
C
C
C     ********************** D I G I S T D *************************
C
C
       DIMENSION X(4001), Y(4001), LABEL(19), SH(50), TH(50), DH(50),
      1INTA(10), INSA(10), NRCSKP(99), DCON(3), CORRS(7), CORRT(7),
      2IREC(1801), AMONCA(13), EVENT(13)
       INTEGER B(8001),ZER,DOL,STAR,ONE,FLAG,DLTREC,ZERO,DLR,BLANK,GCRD,
      1A(2001),TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,TEN,ELEVEN,AMONT,FG
       LOGICAL PRT1,PRT2,PLT1,PLT2,TAPE,ENDFL,CARDS,SKIP,GCARDS
       COMMON /C1/ T(1801),S(1801),D(1801),SV(1801),SIG(1801),
      1S1(1801),T1(1801),D2(1801),S2(1801),T2(1801)
       REAL *8EVENT,WMONTH
       DATA AMONCA/'H','I','C','K','L','O','P','Q','R','U','V','W','Z'/
       DATA EVENT/'AUG 1973','SEP 1973','OCT 1973','NOV 1973','DEC 1973',
      1'JAN 1974','FEB 1974','MAR 1974','APR 1974','MAY 1974','JUN 1974',
      2'JUL 1974','AUG 1974'/
C      ***********************************************************
C
       NAMELIST /CONTRL/ NN,PRT1,PRT2,PLT1,PLT2,TAPE,ENDFL,CARDS,ISTOP,IP
      1,IH,NRCSKP,NSKP,JSKIP,JREC,ISQZ,ICSQZ,IGSQZ,GCARDS,TCOR,SCOR
      2/DAT/SH,TH,DH,IH,ICODE,ISCL,ITSCL,IDSCL,IP,IDEPTH,ISCZ,IGSQZ,ICSQZ
      3,SCOR,TCOR,IHDR,NOIRG,ISTA,TCON,SCON,DCON,CORD,SKIP,CORRS,CORRT,
      4AMONC,TAPE,CARDS,GCARDS
C
C     *************************************************************
C     ************************ DEFINE SYMBOLS *********************
C
C
C     DEFINE SYMBOLS,NOTING THAT THE LEFT THREE HEX BYTES IN EACH
C     ELEMENT OF B END UP FILLED WITH BLANKS
       DATA DOL/'$$$$'/,STAR/Z4040405C/,KEY/Z4040405F/,ONE/Z404040F1/,
      1FLAG/Z40404050/,DLTREC/Z40404060/,MINUS/Z40404061/,
      2 DLR/Z4040405B/,BLANK/'    '/,ZER/Z404040F0/,TWO/Z404040F2/,
      3THREE/Z404040F3/,FOUR/Z404040F4/,FIVE/Z404040F5/,
      4MTWO/Z404040E2/,MTHREE/Z404040E3/,MFOUR/Z404040E4/,MFIVE/Z404040E5
      5/,SIX/Z404040F6/,SEVEN/Z404040F7/,EIGHT/Z404040F8/,NINE/Z404040F9
      6/,TEN/Z404040F0/,ELEVEN/Z4040407B/
C
C     *************************************************************
C     ********************** DEFINE CONSTANTS *********************
C
C
C     THE FOLLOWING CONVERSION FACTORS ARE IN HUNDREDTHS OF INCHES PER
C     UNIT OF S OR T.  THEY MAY BE OVERRIDDEN BY THE DATA CARDS.
       DCON(1) = 3.153
       DCON(2) = 1.261
```

```
      DCON(3) = 0.631
      TCON = 189.680
      SCON = 474.200
C
C      ***********************************************************************
C      *************** INITIALIZE ALL TERMS AND VARIABLES **************
C
      DATA CARDS/.FALSE./,CORD/0.0/,ENDFL/.FALSE./,FG/0/,GCARDS/.FALSE./
     1,ICODE/0/,ICSQZ/1/,IGSQZ/1/,IH/0/,IHDR/0/,IP/0/,IPS/8000/,ISCL/0/,
     2IDEPTH/1/,IDSCL/0/,ISTA/999/,ITSCL/0/,
     3ISQZ/1/,ISTOP/0/,JJJ/0/,JJJJ/0/,JREC/0/,JSAV/0/,KBARF/0/,KSCARF/0/
     4,KDTAF/1/,KDTA/1/,KDT1/1/,KDTH1/1/,KDTH2/1/,KS/1/,KS1/1/,
     5KS2/1/,KT/1/,KT1/1/,KT2/1/,NE/0/,NOIRG/0/,NSKP/0/,PLT1/.FALSE./,
     6PLT2/.FALSE./,PRT1/.TRUE./,PRT2/.FALSE./,SCOR/0.0/,SKIP/.FALSE./,
     7TAPE/.FALSE./,TCOR/0.0/
C
C      ***********************************************************************
C      ********************* INITIALIZE ALL ARRAYS *********************
C
C      GIVE THE ARRAYS INITIAL VALUES
C
C
      DO 20 J=1,50
      SH(J) = 0.0
      TH(J) =-5.0
      DH(J) = 0.0
   20 CONTINUE
C
C
C
C
      DO 30 J=1,1801
      D(J) = 0.0
      T(J) =-5.0
      S(J) = 0.0
      D2(J) = 0.0
      T2(J) =-5.0
      S2(J) = 0.0
      T1(J) =-5.0
      S1(J) = 0.0
      IREC(J) = 0
   30 CONTINUE
C
C
C
C
      DO 40 J=1,99
      NRCSKP(J) = 0
```

```
   40 CONTINUE
C
C
C
C
      DO 50 J=1,7,1
      CORRS(J) = 0.0
      CORRT(J) = 0.0
   50 CONTINUE
C
C
C      PROVIDE INITIAL INDICES FOR 10 SALINITY SEGMENTS (INSA) AND 10
C      TEMPERATURE SEGMENTS (INTA).
      INSA(1) = 1
      INSA(2) = 1
      INTA(1) = 1
      INTA(2) = 1
C
      DO 60 J=3,10
      INSA(J) = 980
      INTA(J) = 980
   60 CONTINUE
C
C      COMPUTE A TABLE OF CONVERSION FACTORS FOR SALINITY AND
C      TEMPERATURE. CORRS AND CORRT REPRESENT THE S OR T VALUE AT THE
C      LEFT HAND SIDE OF THE STD TRACE. THE VALUE (J) TO BE USED WILL
C      COME FROM ISCL AND ITSCL. HYTECH STD MODEL 9006 STANDARD
C      TEMPERATURE AND SALINITY SCALES 1 THRU 7 ARE PROVIDED FOR IN
C      THIS PROGRAM IN ADDITION TO DEPTH SCALES 1,2, AND 3. FOR
C      CONVENIENCE THE SCALES FOR TEMPERATURE, SALINITY, AND DEPTH ARE
C      DEFINED HERE.
C     TEMPERATURE SCALES:
C        ITSCL 1= -2 TO 3  (DEG CELSIUS)
C        ITSCL 2=  2 TO 7  (DEG CELSIUS)
C        ITSCL 3=  6 TO 11 (DEG CELSIUS)
C        ITSCL 4= 10 TO 15 (DEG CELSIUS)
C        ITSCL 5= 14 TO 19 (DEG CELSIUS)
C        ITSCL 6= 18 TO 23 (DEG CELSIUS)
C        ITSCL 7= 22 TO 27 (DEG CELSIUS)
C     SALINITY SCALES:
C        ISCL  1= 30.0 TO 32.0  (PPT)
C        ISCL  2= 31.5 TO 33.5  (PPT)
C        ISCL  3= 33.0 TO 35.0  (PPT)
C        ISCL  4= 34.5 TO 36.5  (PPT)
C        ISCL  5= 36.0 TO 38.0  (PPT)
C        ISCL  6= 37.5 TO 39.5  (PPT)
C        ISCL  7= 30.0 TO 40.0  (PPT)
C     DEPTH SCALES:
```

```
C           DCON(1)=  0.0  TO 300.0   (METERS)
C           DCON(2)=  0.0  TO 750.0   (METERS)
C           DCON(3)=  0.0  TO 1500.0  (METERS)
C
      CORRT(7) = 22.0
      CORRS(7) = 30.0
C
C
      DO 70 J=1,6,1
      FJ = J
      CORRT(J) = -2.0+(FJ-1.0)*4.0
      CORRS(J) = 30.0+(FJ-1.0)*1.5
   70 CONTINUE
C
C
C
C      ****************************************************************
C      ***** BEGIN PROCESSING; READ INITIAL DATA FROM TWO CARDS ********
C      PROGRAM PROVIDES FOR READING NSKP RECORDS WITHOUT PROCESSING.
C      NSKP, AS WELL THE 99 VALUES OF NRCSKP MUST BE ON THE FIRST
C      CONTRL CARD. A SINGLE CONTRL CARD IS READ HERE TO SET NSKP AND
C      NRCSKP. THERE ALSO MAY BE AN INFORMATIVE LABEL EXPLAINING HOW
C      MANY AND WHICH RECORDS SKIPPED.
      READ (5,CONTRL)
      READ (5,170) LABEL
      WRITE (6,180) LABEL
C
C      IF TAPE=.TRUE., TAPE MUST BE REWOUND AND APPROPRIATE JCL MUST
C      BE PROVIDED TO DEFINE IT. SEE JCL FOR EXAMPLE IN PRECEDING
C      PROGRAM DOCUMENTATION SECTION.
      IF (TAPE) REWIND 8
      IF (NSKP.EQ.0) GO TO 140
C
C      ****************************************************************
C      ************************ START SKIP LOOP ***********************
C
C
      DO 80 IS=1,NSKP
      IIS = IS
C
C      THE VARIABLE,IPS, IS SET NEGATIVE DURING THE RECORD SKIP PROCESS.
C      THIS AVOIDS TPRD STOPPING ON UNREADABLE OR BAD RECORDS. NO DATA
C      CARDS ARE REQUIRED FOR INITIALLY SKIPPED RECORDS.
C      IMPORTANT NOTE:  INITIALLY SKIPPED RECORDS (NSKP) DIFFER FROM
C      INDIVIDUALLY SKIPPED RECORDS (NRCSKP) IN THAT NRCSKP REQUIRES
C      DATA CARDS AND PERMITS 99 INDIVIDUAL RECORCS TO BE SKIPPED WHILE
C      NSKP DOES NOT REQUIRE DATA CARDS AND PERMITS MULTIPLE RECORDS TO
C      BE SKIPPED. (IE. NSKP=40, THE FIRST 40 RECORDS ON THE TAPE BEING
```

```
C       READ WILL BE SKIPPED; WHEREAS NRCSKP=22,23,24,50 PERMITS RECORD
C       NUMBERS 22,23,24,50 TO BE SKIPPED INDIVIDUALLY.)
C
      IPS = -8000
   80 CALL TPRD (A,IPS,&100,&120)
C
C
C
C      *****************************************************************
C      *************** RESET IPS FOR NORMAL TAPE PROCESSING ***********
      IPS = 8000
      WRITE (6,90) IIS
   90 FORMAT (/5X,I5,' RECORDS SKIPPED'/)
      GO TO 140
C
C       IF END OR  ERROR MESSAGES OCCUR DURING SKIP ROUTINE, PROGRAM
C       STOPS.
  100 WRITE (6,110) IIS
  110 FORMAT (/5X,'FOUND END OF FILE ON RECORD',I4,'DURING SKIP PROCESS'
     1 /)
      GO TO 1580
  120 WRITE (6,130) IIS,A(1),A(2),A(3),A(4)
  130 FORMAT (/5X,'READ ERROR ON RECORD',I5,'ERROR STATISTICS ARE: ',4Z8
     1)
      GO TO 1580
C      *****************************************************************
C      ************************ END SKIP LOOP ************************
C
C       REDEFINE LOOP INDEX TO START AT ONE.
  140 NNN = NN-NSKP
C
C      *****************************************************************
C      *************** START MAIN LOOP FOR EACH RECORD ****************
      IT = 1
  150 IF (IT.GT.NNN) GO TO 1580
      IPS = 8000
      NREC =  IT+NSKP
      WRITE (6,160) NREC
  160 FORMAT (/5X,'LABEL  150; START MAIN LOOP.  RECORD NO. ',I3/)
C
C       PROGRAM PERMITS TREATMENT OF A KNOWN NUMBER OF RECORDS,NN, OR
C       STOPPING WHEN ISTOP=1 ON STATION LABEL CARD. THE LABEL CARD HAS
C       TWO DIGITS FOR CONTROL. THE 77-TH COLUMN IS JSKIP; IF JSKIP=0,
C       ONLY TWO CARDS ARE READ. THE 78-TH COLUMN IS ISTOP; IF ISTOP=1,
C       THE PROGRAM STOPS. NORMAL TERMINATION OF THE PROGRAM MAY BE
C       ACCOMPLISHED IN TWO DISTINCT WAYS. EITHER SET NN TO DESIRED
C       RECORD TO STOP OR PLACE A 'STATION END' LABEL CARD AT END OF DATA
C       DECK WITH A ONE IN COLUMN 78. THE 79-TH COLUMN IS AMONC; AMONC IS
```

```
C       AN ALPHABETIC LETTER CODE FOR MONTH AND YEAR. THIS CODE IS
C       CONVERTED TO LITERAL MONTH AND YEAR LATER ON IN PROGRAM.
C
      READ (5,170) LABEL,JSKIP,ISTOP,AMONC
  170 FORMAT (19A4,2I1,A1)
      IF (ISTOP.GT.0) GO TO 1580
      READ (5,DAT)
      WRITE (6,180) LABEL
      WRITE (6,DAT)
C       NORMALLY TWO CARDS, LABEL AND DAT, ARE READ PER RECORD.
C       LESS FREQUENTLY CHANGED VARIABLES ARE ON CONTRL DATA CARD.
      JJJJ = 0
      NOIRG = 0
      IF (JSKIP.EQ.0) GO TO 190
      READ (5,CONTRL)
      WRITE (6,CONTRL)
  180 FORMAT (/5X,19A4/)
C
C
C       PROVISION IS MADE HERE FOR A MISSED HEADER LABEL ON TAPE (AN
C       OPERATOR ERROR). IF IHDR=1,AND ALL INFORMATION REQUIRED IS PLACED
C       ON PARTICULAR &DAT CARD, THE PROGRAM BRANCHES OFF TO  610 AND
C       WRITES STATION INFORMATION AND MESSAGE THAT HEADER IS MISSING,
C       AND FINALLY RETURNS TO 150 TO START NORMAL PROCESSING OF TRACE
C       RECORD DATA. NOTE, RECORD COUNT IS NOT INCREMENTED IN THIS LOOP.
C
  190 IF (IHDR.EQ.1) GO TO 610
  200 CONTINUE
C
C       NOTE: IN EARLIER VERSIONS OF THIS PROGRAM, THERE WAS AN
C       INTERPOLATION ROUTINE HERE FOR HAND-ENTERED DATA BUT IT WAS
C       DELETED SINCE VERY SELDOM ONE HAD CAUSE TO USE IT. HOWEVER, THE
C       CAPABILITY FOR HAND-ENTERED DATA HAS BEEN RETAINED BUT IN A
C       DIFFERENT FORM. SEE COMMENTS FOLLOWING STATEMENT NO. 1130.
C
C-------------------
  210 FORMAT (5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.
     12/5X,11F7.2/5X,11F7.2/5X,3F7.2,60X,I6)
  220 FORMAT (5X,10I5,'  INSA')
  230 FORMAT (5X,10I5,'  INTA')
  240 FORMAT (5X,' KS  , KS1, KS2, KT  , KT1, KT2, JJJ, NE ,KDTH1,KDTH2,KD
     1TA,KDT1,JJJJ'/4X,8I5,2I6,3I5)
C-------------------
C
C-------------------
      IPLACE=245
      WRITE (6,210) (D(J),J=1,1801,20)
      WRITE (6,210) (T(J),J=1,1801,20),IPLACE
```

```
      WRITE (6,210) (S(J),J=1,1801,20),IPLACE
      WRITE (6,220) (INSA(J),J=1,10)
      WRITE (6,230) (INTA(J),J=1,10)
      WRITE (6,240) KS,KS1,KS2,KT,KT1,KT2,JJJ,NE,KDTH1,KDTH2,KDTA,KDT1,J
     1JJJ
C-------------------
C
C
C        FILL THE A ARRAY WITH DOLLARS
C
C
      DO 250 I=1,2001
C        THE 2001 ASSURES THAT THE LAST WORD OF A WILL CONTAIN DOLLARS
C        SINCE 2000 WORDS OR 8000 BYTES OF DATA ARE READ IN.
      A(I) = DOL
  250 CONTINUE
C
C
C        FILL B WITH BLANKS
C
C
      DO 260 I=1,8000
      B(I) = BLANK
  260 CONTINUE
C
C        PROGRAM EXAMINES LIST OF INDIVIDUAL BAD RECORDS,NRCSKP,AND
C        SKIPS THEM. IF NRCSKP(1)=0, THE SKIP ROUTINE IS BY-PASSED.
C        CAUTION:  DO NOT REMOVE PAIRS OF DATA CARDS FOR INDIVIDUALLY
C        SKIPPED CARDS.
C
C        IN USING THE CALMA DIGITIZER, SPURIOUS BLANK RECORDS OCCURRED
C        THROUGHOUT THE TAPE ON NUMEROUS OCCASSIONS. MANY OF THESE
C        OCCURRENCES WERE LATER TRACED TO EQUIPMENT MALFUNCTION.
C        HOWEVER, IF A BLANK RECORD OCCURS DURING A HEADER LABEL RECORD
C        NOTHING IS LOST SINCE HEADER INFO MAY BE INSERTED BY CARD AND
C        SETTING IHDR=1. ON THE OTHER HAND, IF A BLANK RECORD OCCURS
C        DURING A TRACE RECORD THE COMPLETE STATION IS LOST. FROM
C        EXPERIENCE, A BLANK RECORD WILL GENERALLY HAVE TWO CHARACTERS.
C        AFTER THE FIRST PROGRAM RUN AND A DETERMINATION OF BLANK OR
C        BAD RECORDS HAS BEEN MADE, THESE MAY BE SKIPPED INDIVIDUALLY VIA
C        NRCSKP ROUTINE.
      IF (NRCSKP(1).EQ.0) GO TO 320
C
C
C        ****************************************************************
C        *************** START INDIVIDUAL RECORD SKIP LOOP ***************
C
C
```

```
      DO 270 LB=1,99
      NRC = NRCSKP(LB)-NSKP
      IF (NRC.EQ.IT) GO TO 280
  270 CONTINUE
C
      GO TO 300
  280 IPS = -8000
  290 FORMAT (//5X,'LABEL 290. RECORD NO.',I5,' SKIPPED VIA NRCSKP SKIP
     1 ROUTINE.'//)
      WRITE (6,290) IT
C     CHANGING IPS TO NEGATIVE CAUSES TPRD  TO SKIP A RECORD
  300 IF (ICODE.EQ.0) GO TO 320
      WRITE (6,310) IDEPTH,ICODE,ISCL
  310 FORMAT (5X,'SALINITY VERSUS DEPTH'/
     1 5X,'STD RECORD STARTS AT ',I3,' METERS'/
     2 5X,'CODE =  ',I2/
     3 5X,'SCALE = ',I2/)
C
C       ******************************************************************
C       ********************** READ TAPE ********************************
  320 CALL TPRD (A,IPS,&350,&330)
C
C       IPS IS THE MAXIMUM NUMBER OF BYTES OF DATA WHICH WILL BE READ
C       FROM ONE RECORD OF DIGITIZER TAPE BY TPRD. IPS/2 IS THE MAXIMUM
C       TOTAL TRAVEL ALONG THE CURVE MEASURED IN 0.01 INCHES IN THE X
C       AND Y DIRECTION SEPARATELY. 350 IS THE END OF FILE EXIT, AND 330
C       IS THE READ-ERROR EXIT.
      GO TO 360
  330 WRITE (6,340) A(1),A(2),A(3),A(4)
  340 FORMAT (5X,'I10 ERROR STATISTICS TABLE IS ',4Z8)
C
  350 CONTINUE
  360 CONTINUE
C
C       ******************************************************************
C       *************** END INDIVIDUAL RECORD SKIP LOOP ***************
C
C       PROCESS THE LAST RECORD
C       MOVE THE BYTES OF A INTO THE 4-BYTE WORDS OF B USING CHMOVE.
      JJ = 0
      JJJ = 0
C
C
      DO 370 II=1,2000
C
C
      DO 370 I=1,4
      JJ = JJ+1
```

```
      CALL CHMOVE (A(II),I,B(JJ),4)
      IF (B(JJ).EQ.DLR) GO TO 380
C      END OF DATA DETECTED
C      THERE MAY BE A STAR BEFORE THE DOLLAR
  370 CONTINUE
C
C
  380 CONTINUE
      B(8001) = DLR
C
C      ***********************************************************************
C      ***************** PREPARE TO PROCESS RAW ARRAY *****************
C
      WRITE (6,390) JJ,(B(J),J=1,25)
  390 FORMAT (/5X,'LABEL 390.  ARRAY B IS FILLED; LOOK FOR MODE CHARACTE
     1R.  THE NUMBER OF ARRAY ELEMENTS PROCESSED INCLUDING STARS AND '/
     2 5X,'DOLLARS, JJ= ',I5,/5X,'FIRST  25 CHARACTERS ARE: ',
     3 10(1X,Z8)/5X,10(1X,Z8)/5X,5(1X,Z8)/)
C
C     ************************************************************************
C
      JJ = 1
      GO TO 430
C
C      ***********************************************************************
C      ******************* START MISSING IRG ROUTINE ******************
C
C      THE FOLLOWING ROUTINE READS ANOTHER SET OF CARDS.  THIS IS THE
C      ENTRY FOR THE SITUATIONS IN WHICH THE IRG IS MISSED.
  400 READ (5,170) LABEL,JSKIP,ISTOP,AMONC
      IF (ISTOP.GT.0) GO TO 1580
      IF (JSKIP.EQ.0) GO TO 410
      READ (5,DAT)
      WRITE (6,180) LABEL
      WRITE (6,DAT)
      READ (5,CONTRL)
      WRITE (6,CONTRL)
C------------------
  410 IPLACE=410
      WRITE (6,210) (D(J),J=1,1801,20)
      WRITE (6,210) (T(J),J=1,1801,20),IPLACE
      WRITE (6,210) (S(J),J=1,1801,20),IPLACE
      WRITE (6,220) (INSA(J),J=1,10)
      WRITE (6,230) (INTA(J),J=1,10)
      WRITE (6,240) KS,KS1,KS2,KT,KT1,KT2,JJJ,NE,KDTH1,KDTH2,KDTA,KDT1,J
     1JJJ
      WRITE (6,420) NOIRG,JJJJ
  420 FORMAT (/5X,'LABEL 410.  PROCESSING SECOND HALF.  NOIRG=',I3,
```

```
      1 'JJJJ=',I5/)
C-------------------
      NOIRG = 0
      JJ = JJJJ
C
C       ****************************************************************
C       ******************END MISSING IRG ROUTINE *********************
C
C       INITIALIZE ADDERS,ETC.
  430 SUMD = 0.
      SUMD = 0.
      SUMT = 0.
      N = 0
      KL = 0
      KK = 0
C
C       ****************************************************************
C       ********************** MODE SYMBOL CHECK *********************
C
  440 IF (B(JJ).EQ.KEY) GO TO 490
C       THE FIRST ELEVEN VALUES OF THE B-ARRAY ARE CHECKED FOR A
C       KEYBOARD SYMBOL SINCE IT IS POSSIBLE TO HAVE GARBAGE VALUES AHEAD
C       OF THE KEYBOARD SYMBOL. IF ALL ELEVEN VALUES ARE NOT KEYS
C       THEN JJ IS RESET TO 1 AND THE RECORD IS PROCESSED AS A TRACE.
C       HOWEVER, IF ONE OF THE ELEVEN VALUES ARE A KEY, PROGRAM BRANCHES
C       TO 490, AND PROCESSES AS A HEADER. AT FIRST GLANCE, THIS
C       PROCEDURE APPEARS TO ASSUME THAT IT IS IMPOSSIBLE TO HAVE A
C       KEY SYMBOL APPEAR IN THE FIRST ELEVEN CHARACTERS OF A TRACE
C       RECORD. THIS IS NOT A BAD ASSUMPTION SINCE THE OPERATOR HAS TO
C       GO OUT OF HIS WAY TO INITIATE KEYBOARD MODE DURING TRACE MODE.
C       HOWEVER, LEAVING NOTHING TO CHANCE THE PROGRAM WILL KEEP
C       CHECKING FOR KEY OR TRACER UNTIL OPERATOR MAKES UP HIS MIND
C       WHICH MODE IS CORRECT. IF NO TRACER SYMBOLS APPEAR AFTER PROGRAM
C       FINDS A KEY, THEN RECORD WILL BE PROCESSED AS A HEADER. ON THE
C       OTHER HAND, IF NO KEY SYMBOLS APPEAR AFTER PROGRAM FINDS A TRACER
C       THEN THE RECORD WILL BE PROCESSED AS A TRACE.
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
```

```
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 490
      JJ = JJ-10
      IF (KL.EQ.1) GO TO 500
      IF (KL.EQ.2) GO TO 500
C      NO KEYBOARD SYMBOL; MAY HAVE FORGOTTEN IT. TEST THE 5TH AND
C      6TH SYMBOLS (IDEPTH).  IF BOTH ARE NINES CALL IT A KEYBOARD.
      IF (B(5).EQ.NINE.AND.B(6).EQ.NINE) GO TO 450
      GO TO 670
  450 IJJ = JJ+12
      WRITE (6,460) (B(I),I=JJ,IJJ)
  460 FORMAT (/5X,'AT 450, MISSING KEY.  B(1) TO B(13)=',13A1/)
      GO TO 500
C
  470 WRITE (6,480)
  480 FORMAT (5X,'FOUND EIGHT KEYBOARD SYMBOLS IN SEQUENCE.   STOP.')
      GO TO 1570
  490 KL = KL+1
      JJ = JJ+1
C      A CHECK IS MADE HERE FOR MULTIPLE KEYBOARD SYMBOLS. IF NUMBER
C      EXCEEDS EIGHT, PROGRAM TERMINATES. THE NUMBER EIGHT IS ARBITRARY
C      BUT ONE WOULD PROBABLY NOT WANT TO USE A NUMBER GREATER THAN 12
C      (IE. ONE LESS THAN NUMBER OF CHARACTERS IN HEADER). EXPERIENCE
C      INDICATES THAT SELDOM DOES ONE INCUR MORE THAN THREE KEYBOARD
C      SYMBOLS ON A TAPE PER RECORD.
      IF (KL.EQ.8) GO TO 470
      IF (B(JJ).EQ.STAR) GO TO 670
C      TRY AGAIN
      GO TO 440
C
C      ***************************************************************
C      ******************** START KEYBOARD DECODE ******************
C
C      PROCESS KEYBOARD ENTRIES.  CHANGE THE WORDS TO
C      INTEGER FORM BY SUBTRACTING Z404040F0 AND CREATE MULTI-DIGIT
C      INTEGERS
C      SKIP=T PERMITS NAMELIST DATA TO OVERRIDE HEADING DATA.  ALL THE
C      HEADING DATA MUST THEN BE ON THE NAMELIST CARDS.
  500 IF (SKIP) GO TO 610
      ISTAA = 0
      IDEPT = 0
C      DEFINE INDICES FOR DECODING THE LABEL
```

```
      KY1 = JJ
      KY2 = KY1+2
      KY3 = KY1+3
      KY4 = KY1+4
      KY5 = KY1+5
      KY6 = KY1+6
      KY7 = KY1+7
      KY8 = KY1+8
      KY9 = KY1+9
      KY10 = KY1+10
      KY11 = KY1+11
C
C      DLTREC ARE FOUND HERE IN THE HEADER.  IF DLTREC OCCURS , READ IN
C      A NEW RECORD AND USE SAME CARDS.
C
C
      DO 510 J=KY1,KY10
      IF (B(J).EQ.DLTREC) GO TO 520
  510 CONTINUE
C
C
      GO TO 550
  520 WRITE (6,530)
  530 FORMAT (/5X,'DLTREC IN HEADER. REPEAT,USING SAME CARDS.'/)
  540 IT = IT+1
      GO TO 200
  550 KT2 = 10
      KS2 = 10
C      THESE TWO STATEMENTS GIVE MAXIMUM VALUES TO KT2 AND KS2 SO THAT
C      THEY WILL ALWAYS BE DEFINED, EVEN IF  ONLY ONE VARIABLE IS TRACED
C
C      DO THE CONVERSION, COMPARE WITH VALUES READ FROM THE CARDS,ACCEPT
C      THE CARDS.
C
C
      DO 560 J=KY1,KY2
      B(J) = B(J)-ZER
      IB = B(J)
      ISTAA = ISTAA+IB*10**(KY2-J)
  560 CONTINUE
C
      AMONT = B(KY3)
C
C
      DO 570 J=KY4,KY5
      B(J) = B(J)-ZER
      IB = B(J)
      IDEPT = IDEPT+IB*10**(J-KY4)
```

```
  570 CONTINUE
C
      IDSC = B(KY6)-ZER
      ICOD = B(KY7)-ZER
      ITSCL1 = B(KY8)-ZER
      ISCL1 = B(KY9)-ZER
      IPP = B(KY10)-ZER
C
C      IF THERE IS A DISAGREEMENT, WRITE A MESSAGE.
      IF (ISTAA.NE.ISTA) GO TO 590
      IF (IDEPT.NE.IDEPTH) GO TO 590
      IF (IDSC.NE.IDSCL) GO TO 590
      IF (ICOD.NE.ICODE) GO TO 590
      IF (ITSCL1.NE.ITSCL) GO TO 590
      IF (ISCL1.NE.ISCL) GO TO 590
      IF (IPP.NE.IP) GO TO 590
  580 FORMAT (5X,'LABEL= 580.  CARD INPUTS EQUALLED TAPE HEADER FOR
     1 STATION ',I3,A1/5X,'IDEPTH= ',I3/)
      WRITE (6,580) ISTA,AMONC,IDEPTH
      GO TO 610
  590 WRITE (6,600) ISTA,AMONC,IDEPTH,IDSCL,ICODE,ITSCL,ISCL,IP,ISTAA,AM
     1ONT,IDEPT,IDSC,ICOD,ITSCL1,ISCL1,IPP
  600 FORMAT (/3X'CARD AND TAPE DISAGREE, CARD ON TOP'/3X,'    ISTA  AMON
     1C   IDEPTH  IDSCL  ICODE  ITSCL   ISCL    IP'/3X,I7,A7,6I7/3X,I7
     2 ,A7,6I7/)
C      WRITE THE RESULTS
  610 WRITE (6,620) ISTA,AMONC,IDEPTH
  620 FORMAT (5X,'LABEL 610.  HEADER PROCESSING COMPLETE EXCEPT SEARCH F
     1OR ERRORS ON STATION ',I3,A1/5X,'IDEPTH= ',I3/)
C
C
C      IT IS POSSIBLE THAT NO IRG EXISTS AFTER THE HEADER.IF SO,
C      THE PROGRAM HAS FILLED THE B ARRAY WITH BOTH THE HEADER AND TEMP.
C      OR SALINITY TRACE. ASSUME THERE IS A TRACER SYMBOL IN POSITION
C      12. IF SO, CONTINUE TO PROCESS THE B-ARRAY
      IF (B(KY11).NE.STAR) GO TO 640
      JJJJ = KY11
      WRITE (6,630)
  630 FORMAT (/5X,'NO IRG AFTER HEADER; CONTINUE TO PROCESS B ARRAY.'/)
      GO TO 400
  640 IF (IHDR.EQ.0) GO TO 660
C
C      THIS BRANCH RETURNS TO 150 IF MISSED HEADER AND IHDR SET EQUAL 1.
      WRITE (6,650)
  650 FORMAT (/5X,'HEADER MISSING; INFO INSERTED WITH CARDS.'/)
      IHDR = 0
      GO TO 150
  660 CONTINUE
```

```
      GO TO 1550
C      ***************************************************************
C      ********************** END KEYBOARD DECODE ********************
C
C
C      ***************************************************************
C      ***************** START OF NORMAL TRACE PROCESSING ************
C
C      THE FOLLOWING PROCEDURE PERMITS THE PRESENCE OF ANY REASONABLE
C      NUMBER OF TRACER SYMBOLS (STAR) INCLUDING NONE.
  670 NE = 0
      NF = 0
      NSTAR = 0
  680 IF (B(JJ).EQ.STAR) GO TO 700
C
C      COUNT STARS AND WRITE MESSAGE
      WRITE (6,690) NSTAR
  690 FORMAT (/5X,'START TRACER MODE; NO. OF TRACER SYMBOLS =',I2/)
C      WHEN THERE ARE NO MORE STARS, START TESTING FOR COUNT SYMBOLS ETC
      GO TO 710
  700 JJ = JJ+1
      NSTAR = NSTAR+1
C      WE CONTINUE TO TEST FOR STARS UNTIL NO MORE APPEAR.
      GO TO 680
C
C      THE NEXT BLOCK OF OPERATIONS TO STATEMENT NO. 950 LOOPS BACK TO
C      710 CONTINUALLY, TESTING EACH CHARACTER FOR IDENTITY AND
C      CONTINUING TO ADD OR SUBTRACT FROM THE CUMULATIVE Y AND X COUNTS
C      UNTIL A DELETE-RECORD SYMBOL OR A STAR OR A DOLLAR INDICATES
C      THE END OF DATA.  THE FLAG IS PLACED AT THE POINT WHERE THE TRACE
C      ENTERS THE CROSS-SECTIONED AREA; PREVIOUS COUNTS RESULT FROM THE
C      TRACER TRAVELLING FROM THE COORDINATE ZERO TO THIS POINT.
  710 IF (B(JJ).EQ.ONE) GO TO 730
      IF (B(JJ).EQ.BLANK) GO TO 740
      IF (B(JJ).EQ.MINUS) GO TO 750
      IF (B(JJ).EQ.FLAG) GO TO 900
C      THE NEXT GROUP OF STATEMENTS ALLOW FOR OCCASIONAL COUNTS GREATER
C      THAN + OR - 1.
      IF (B(JJ).EQ.TWO) GO TO 760
      IF (B(JJ).EQ.THREE) GO TO 770
      IF (B(JJ).EQ.FOUR) GO TO 780
      IF (B(JJ).EQ.FIVE) GO TO 790
      IF (B(JJ).EQ.SIX) GO TO 800
      IF (B(JJ).EQ.SEVEN) GO TO 810
      IF (B(JJ).EQ.EIGHT) GO TO 820
      IF (B(JJ).EQ.NINE) GO TO 830
      IF (B(JJ).EQ.TEN) GO TO 840
      IF (B(JJ).EQ.ELEVEN) GO TO 850
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      IF (B(JJ).EQ.MTWO) GO TO 860
      IF (B(JJ).EQ.MTHREE) GO TO 870
      IF (B(JJ).EQ.MFOUR) GO TO 880
      IF (B(JJ).EQ.MFIVE) GO TO 890
      IF (B(JJ).EQ.DLTREC) GO TO 970
      IF (B(JJ).EQ.KEY) GO TO 440
  720 FORMAT (//5X,'SYMBOL NOT RECOGNIZED = ',Z8//)
      WRITE (6,720) B(JJ)
C      IF SYMBOL IS NOT RECOGNIZED, STATION DATA IS NOT PRINTED IF IP=1.
C      PROGRAM BRANCHES AND RE-INITIALIZES ALL VARIABLES FOR PROCESSING
C      NEXT STATION IF IP=1. OTHERWISE, IT RETURNS TO READ NEXT RECORD.
      IF (IP.EQ.1) GO TO 1510
      GO TO 1570
  730 RX = 1.
      GO TO 910
  740 RX = 0.
      GO TO 910
  750 RX = -1.
      GO TO 910
  760 RX = 2.
      GO TO 910
  770 RX = 3.
      GO TO 910
  780 RX = 4.
      GO TO 910
  790 RX = 5.
      GO TO 910
  800 RX = 6.
      GO TO 910
  810 RX = 7.
      GO TO 910
  820 RX = 8.
      GO TO 910
  830 RX = 9.
      GO TO 910
  840 RX = 10.
      GO TO 910
  850 RX = 11.
      GO TO 910
  860 RX = -2.
      GO TO 910
  870 RX = -3.
      GO TO 910
  880 RX = -4.
      GO TO 910
  890 RX = -5.
      GO TO 910
  900 JJJ = NE
```

```
      JJ = JJ+1
      FG = 1
      GO TO 710
C
C      PROGRAM ADDS AND STORES CUMULATIVE SUMS. ONE UNIT EQUALS 0.01
C      INCH.
  910 N = N+1
      NE = N/2
      NF = NE*2
      IF (NF.EQ.N) GO TO 920
C      THIS FIDDLING AROUND DETERMINES IF THE COUNT IS EVEN OR ODD.
C      START COUNTING IN THE ORDER YXYX.  X AND Y HAVE NORMAL
C      ORIENTATIONS ON THE STRIP CHART. HOWEVER, X AND Y ARE INVERTED
C      WITH RESPECT TO THE CALMA DIGITIZER. SPECIFICALLY, DEPTH
C      INCREASES ALONG THE POSITIVE X-AXIS AND TEMP AND SALINITY ARE
C      INCREASING FUNCTIONS ALONG THE Y-AXIS ON THE CALMA DIGITIZER.
C      WARNING: DIGITIZE TRACES ACCORDING TO ABOVE ORIENTATION OR BE
C      PREPARED TO RE-DIGITIZE TAPE LATER AFTER DISCOVERING GOOF.
C
C      IF ODD
      SUMD = SUMD+RX
C      ODD INDEX IS INCREASED TO KEEP IT SAME AS EVEN.
      NE = NE+1
      Y(NE) = SUMD
      JJ = JJ+1
      GO TO 930
C      IF EVEN
  920 SUMT = SUMT+RX
      X(NE) = SUMT
      JJ = JJ+1
C      IF STAR OR DOLLAR FOUND, END OF DATA HAS BEEN REACHED.
  930 IF (B(JJ).EQ.DLR) GO TO 990
C      ************************************************************
C      **************** END OF NORMAL TRACE PROCESSING ***************
C
C
C      ************************************************************
C      ******************** BEGIN TROUBLE-SHOOTING ******************
C      IF THERE IS NO IRG AT END OF HEADER BUT THERE IS A TRACER SYMBOL,
C      THE PROGRAM SEPARATES THE TWO RECORDS BY FIRST SETTING NOIRG=1
C      AND PROCESSING FIRST PART OF B-ARRAY AND THEN READING A NEW SET
C      OF CARDS TO PROCESS SECOND PART OF B-ARRAY.
      IF (B(JJ).NE.STAR) GO TO 950
      NOIRG = 1
C      SAVE THE INDEX OF THE START OF THE SECOND HALF, JJJJ.
      JJJJ = JJ
      WRITE (6,940)
  940 FURMAT (/5X,'FOUND A STAR AT END OF TRACER ASSUME THERE IS NO IRG.
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```
      1'/5X,'PROCESS RECORD IN TWO PARTS, READING CARDS FOR BOTH PARTS.'/
      2)
       GO TO 990
   950 IF (B(JJ).NE.KEY) GO TO 710
       JJJJ = JJ
       WRITE (6,960)
   960 FORMAT (/5X,'FOUND A KEYBOARD SYMBOL.  PROCESS NEXT PORTION OF B-A
      1RRAY AFTER READING NEW CARDS.'/)
       NOIRG = 1
       GO TO 990
C
   970 WRITE (6,980) JJ
   980 FORMAT (5X,'FOUND DELETE RECORD SYMBOL AT JJ= ',I5)
C       IF DELETE RECORD FOUND, PROGRAM INCREMENTS RECORD COUNT,IT,
C       AND RESTARTS PROCESSING BUT DOES NOT READ A NEW PAIR OF CARDS.
       GO TO 540
   990 JJ = JJ-1
C
C       ******************************************************************
C       ********** END TRACER AND ASSOCIATED TROUBLE-SHOOTING ***********
C
C       UP TO THIS POINT, PROCESSING IS IDENTICAL FOR S AND T.
C       START CONVERTING T AND D TO SCIENTIFIC UNITS
       WRITE (6,1000) JJJ,NE,Y(NE),X(NE)
  1000 FORMAT (/5X,'LABEL 1000. START CONDENSING UNCONVERTED ARRAY AND CO
      1NVERTING TO SCIENTIFIC UNITS.'/5X,'THE TRACER ENTERED THE FRAME (F
      2LAG) AT JJJ= ',I5/5X,'THE END OF THE TRACE HAS INDEX NE= ',I5/
      3 5X,'LAST (UNCONVERTED) DEPTH AND TEMP ARE: ',F7.1,2X,F7.1/)
C
C
C       CHECK TO SEE IF FLAG WAS FOUND.
       IF (FG.EQ.1) GO TO 1020
       WRITE (6,1010)
  1010 FORMAT (/5X,'NO FLAG FOUND; PROCESS ANYWAY.'/)
  1020 WRITE (6,1030)
  1030 FORMAT (' ')
       FG = 0
C
C       THE X AND Y ARRAYS ARE FILLED AND THE START AND END OF THIS BATCH
C       OF DATA ARE LABELLED WITH JJJ AND NE.
C       CONVERT THE ARRAYS INDEXED ON 0.01-INCH DEPTH SPACINGS.
C       SUBROUTINE CONDNS SERVES THIS PURPOSE ALTHOUGH IT NO LONGER
C       CONDENSES  A SECOND ARRAY TO SMALLER SIZE, NOR DOES IT PAD THE
C       GAP BETWEEN ARRAYS, BUT WITHIN ONE SEGMENT, IT DOES INTERPOLATE
C       TO FILL ANY BLANK ARRAY POSITIONS.
C
C
C       TO THOSE FAMILIAR WITH EARLIER VERSIONS OF THIS PROGRAM, THE
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C       FOLLOWING CONDENSE ROUTINES WILL NOT EVEN APPEAR REMOTELY
C       SIMILAR. THE EARLIER VERSION HAD TO BE EXTENSIVELY MODIFIED
C       TO PERMIT MULTIPLE DEPTH SCALES. SPECIFICALLY, WHEN USING
C       MULTIPLE DEPTH SCALES ONE'S DEPTH AXIS REFERENCE CHANGES AND
C       CONSEQUENTLY IN CONSTRUCTING THE S AND D OR T AND D ARRAYS
C       THIS ROUTINE WORKS WELL.
      IF (ICODE.EQ.0) GO TO 1080
C   *                                                                   *
C   S*******************************************************************S
C       CONDENSE THE X AND Y ARRAYS INTO S AND D
C   S*******************************************************************S
C   *                                                                   *
      KS = KS+2
      KS1 = KS-1
      KS2 = KS+1
      IF (IDSCL.EQ.1) GO TO 1040
      KDT1 = KSCARF+1
      GO TO 1050
 1040 KDT1 = INSA(KS1)
 1050 CALL CONDNS (X,Y,S1,JJJ,NE,KDT1,KDTH1,KDTH2)
      KDTA = KDTH1+1
      K = KDTH1
      IF (IDSCL.EQ.1) GO TO 1060
      K = KDT1
C
C
 1060 DO 1070 J=KDTH1,KDTH2
      D(K) = (J-1)/DCON(IDSCL)+CORD
      S(K) = S1(J)/SCON+CORRS(ISCL)+SCOR
      K = K+1
      KSCARF = K
 1070 CONTINUE
C
C
      INSA(KS) = KDTH1
      INSA(KS2) = KDTH2
      GO TO 1130
C   *                                                                   *
C   T*******************************************************************T
C       CONDENSE THE X AND Y ARRAYS INTO T AND D
C   T*******************************************************************T
C   *                                                                   *
 1080 KT = KT+2
      KT1 = KT-1
      KT2 = KT+1
      IF (IDSCL.EQ.1) GO TO 1090
      KDT1 = KBARF+1
      GO TO 1100
```

```
 1090 KDT1 = INTA(KT1)
 1100 CALL CONDNS (X,Y,T1,JJJ,NE,KDT1,KDTH1,KDTH2)
      KDTA = KDTH1+1
      K = KDTH1
      IF (IDSCL.EQ.1) GO TO 1110
      K = KDT1
C
C
 1110 DO 1120 J=KDTH1,KDTH2
      D(K) = (J-1)/DCON(IDSCL)+CORD
      T(K) = T1(J)/TCON+CORRT(ITSCL)+TCOR
      K = K+1
      KBARF = K
 1120 CONTINUE
C
C
      INTA(KT) = KDTH1
      INTA(KT2) = KDTH2
C   *                                                                       *
C   T***********************************************************************T
 1130 CONTINUE
C
C       ****************************************************************
C       ********************** HAND-ENTERED DATA ***********************
C
C       CONVERSION OF X AND Y ARRAYS INTO T AND S ARRAYS IS COMPLETE.
C       AT THIS POINT, SURFACE AND NEAR-SURFACE DATA WILL BE INSERTED.
C       NORMALLY, ONLY SURFACE VALUES NEED TO BE INSERTED DUE TO THE
C       DIGITIZER OPERATOR BEGINNING TO TRACE SLIGHTLY BELOW HIS ZERO
C       DEPTH REFERENCE POINT. SURFACE DATA VALUES ARE INSERTED BY
C       CHECKING THE VALUE OF IH. IF IH=0, DATA IS NOT INSERTED. IF IH=1,
C       SURFACE DEPTH,TEMP, AND SALINITY VALUES ARE INSERTED VIA &DAT
C       DATA CARD FOR PARTICULAR STATION.
C       CAUTION: HAND-ENTERED DATA VALUES SHOULD BE CORRECTED VALUES
C       IF CORRECTIONS,TCOR AND SCOR, ARE APPLICABLE.
C       INFREQUENTLY, DATA VALUES BELOW THE SURFACE MUST BE INSERTED.
C       PROVISION IS MADE FOR NEAR-SURFACE DEPTHS DOWN TO APPROXIMATELY
C       15 METERS. THIS OCCURS DUE TO THE SAME REASON AS ABOVE(IE. A NOT
C       SO METICULOUS OPERATOR BEGAN DIGITIZING BELOW ZERO REFERENCE
C       POINT.). SINCE THIS OCCURS SELDOM, AND INVOLVES A SIGNIFICANT
C       AMOUNT OF LABOR TO MANUALLY READ THE STD TRACE, CORRECT THE
C       VALUES IF NEEDED AND PLACE ON &DAT CARD, THIS OPERATION WILL
C       ONLY BE DONE FOR FINAL OUTPUT TO TAPE,CARD OR PRINTER.
C       CONSEQUENTLY, TO INSERT NEAR-SURFACE DATA ISQZ MUST EQUAL 1,
C       IH MUST BE GREATER THAN OR EQUAL TO 2. DH,TH, AND SH WERE
C       DIMENSIONED AT 50. THIS EQUATES TO APPROXIMATELY 15 METERS.
C       ISQZ=1 WAS CHOSEN AS DETERMINING VALUE DUE ALL ELEMENTS OF D,T,
C       AND S ARRAYS ARE PRINTED OUT VIA OUT1. THIS ELIMINATES
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C       'GUESSWORK' OF WHICH VALUES SHOULD BE INSERTED. IN OTHER WORDS,
C       ALL OF THEM ARE INSERTED.
      IF (IH.EQ.0) GO TO 1150
      S(1) = SH(1)
      T(1) = TH(1)
      IF (IH.LT.2) GO TO 1150
      IF (ISQZ.GT.1) GO TO 1150
C
C
      DO 1140 J=2,IH
      S(J) = SH(J)
      T(J) = TH(J)
      D(J) = DH(J)
 1140 CONTINUE
C
C
 1150 CONTINUE
C  *                                                                   *
C-------------------
      IPLACE=1155
      WRITE (6,210) (D(J),J=1,1801,20)
      WRITE (6,210) (T(J),J=1,1801,20),IPLACE
      WRITE (6,210) (S(J),J=1,1801,20),IPLACE
      WRITE (6,220) (INSA(J),J=1,10)
      WRITE (6,230) (INTA(J),J=1,10)
      WRITE (6,240) KS,KS1,KS2,KT,KT1,KT2,JJJ,NE,KDTH1,KDTH2,KDTA,KDT1,J
     1JJJ
C-------------------
C
      IF (IP.EQ.1) GO TO 1160
      IF (NOIRG.EQ.1) GO TO 400
      GO TO 1570
 1160 IN1 = KBARF
      IN2 = KSCARF
      KDTA = MIN0(IN1,IN2)
 1170 FORMAT (5X,'LABEL=1170.',3I7//)
      WRITE (6,1170) IN1,IN2,KDTA
C       ***************************************************************
C       ********** EDITING OF UNWANTED ZERO DATA VALUES ***************
C
C       IN DIGITIZING TEMP AND SALINITY SEGMENTS OF TRACES ONE CAN NOT
C       AVOID GETTING GAPS SOMETIMES BETWEEN TRACE SEGMENTS. WHEN THIS
C       HAPPENS THE OUTPUT PRINTOUT WILL SHOW -5.0 AND 0.0 FOR THE
C       TEMPERATURE AND SALINITY VALUES RESPECTIVELY. THESE VALUES ARE
C       THE PRE-INITIALIZED VALUES OF THE T AND S ARRAYS, AND INDICATE
C       NO ATTEMPT HAS BEEN MADE TO PLACE DATA IN THE PARTICULAR ARRAY
C       POSITION (IE A GAP IN DATA). IT IS DESIRABLE THAT THESE UNWANTED
C       VALUES OR GAPS BE ELIMINATED PRIOR TO WRITING A TAPE OR PUNCHING
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```
C        A CARD. THUS A CHECK IS MADE TO SEE IF T(J) OR S(J) ARE -5.0 OR
C        0.0 RESPECTIVELY. IF T(J) AND S(J) ARE NOT -5.0 OR 0.0
C        RESPECTIVELY, THE VALUES ALONG WITH DEPTH ARE PLACED INTO D2,T2,
C        AND S2 ARRAYS. IF GAPS DO EXIST, THE VALUES ARE WRITTEN OUT AND
C        COUNTED BUT NOT PUT INTO THE D2,T2,AND S2 ARRAYS.  THIS PROCESS
C        IN EFFECT DISCARDS THE GAPS IN THE DATA. THE D,T, AND S ARRAYS
C        ARE THEN RE-INITIALIZED, AND THE D2,T2,AND S2 ARRAYS ARE PUT BACK
C        INTO THE D,T,AND S ARRAYS. NOTE, THE VALUE OF KDTA WHICH
C        IS EQUAL TO TOTAL NUMBER OF RECORDS IS REDUCED BY NUMBER OF
C        UNWANTED RECORDS BY MAKING USE OF THE VARIABLE KDTAF.
      K = 0
      L = 1
C
C
      DO 1200 J=1,KDTA
      IF ((T(J).EQ.-5.0).OR.(S(J).EQ.0.0)) GO TO 1180
      D2(L) = D(J)
      T2(L) = T(J)
      S2(L) = S(J)
      L = L+1
      GO TO 1200
 1180 WRITE (6,1190) D(J),T(J),S(J),J
      K = K+1
      JSAV = K
 1190 FORMAT (//5X,3F7.2,I6,//)
 1200 CONTINUE
C
C
 1210 FORMAT (//5X,' JSAV=',I6,//)
      WRITE (6,1210) JSAV
      KDTAF = KDTA-JSAV
      KDTA = KDTAF
C
C
      DO 1220 J=1,1801
      D(J) = 0.0
      T(J) =-5.0
      S(J) = 0.0
 1220 CONTINUE
C
C
C
C
      DO 1230 J=1,KDTA
      D(J) = D2(J)
      T(J) = T2(J)
      S(J) = S2(J)
 1230 CONTINUE
```

```
C
C
C     ******************************************************************
C     ****************** SOUND VELOCITY AND SIGMA-T *****************
C
C     PRODUCE SOUND VELOCITY AND SIGMA-T WHEN IP.EQ.1
      CALL SVEL (D,T,S,SV,KDTA)
      CALL SIGMT (S,T,SIG,KDTA)
C
C     ******************************************************************
C     *********** CONSECUTIVE RECORD SERIALIZATION ROUTINE ***********
C
C     ARRAYS ARE COMPLETE AT THIS POINT FROM INDEX 1 TO THE END OF
C     THE SMALLER OF THE SALINITY OR TEMPERATURE ARRAYS.
C     GENERATE SERIAL NUMBERS FOR THE RECORDS.
      IF (JREC.GT.18) GO TO 1240
      JREC = 1
 1240 CONTINUE
C
C
      DO 1250 J=1,KDTA
      JREC = JREC+1
      IREC(J) = JREC
 1250 CONTINUE
C
C
C     ******************************************************************
C     ***********************   O U T P U T   ***********************
C
C
C     THIS SECTION CONVERTS THE LETTER DESIGNATOR FOR MONTH(AMONC) FROM
C     THE SINGLE LETTER CODE ON THE DIGITIZED TAPE TO THE APPROPRIATE
C     MONTH AND YEAR IN PREPARATION FCR WRITING THE OUTPUT.
C
C
      DO 1260 J=1,13
      IF (AMONC.EQ.AMONCA(J)) GO TO 1280
 1260 CONTINUE
C
C
 1270 FORMAT (15X,'AMONC NEVER DID EQUAL AMONC(J).  CONSEQUENTLY,
     1WMONTH WILL NOT BE DEFINED.'/)
      WRITE (6,1270)
      GO TO 1290
 1280 WMONTH = EVENT(J)
 1290 CONTINUE
C
C     ******************************************************************
```

```
C        ************* OCEANOGRAPHIC DATA STATION SUMMARIES *************
C
      IF (.NOT.PRT1) GO TO 1300
C
C        PRINT DATA
      WRITE (6,1560)
C        THE PARAMETER ISQZ PERMITS CONDENSING THE PRINTED DATA BY THE
C        FACTOR ISQZ
      CALL OUT1 (D,T,S,SV,SIG,KDTA,ISTA,WMONTH,IREC,JREC,ISQZ)
C
C        ****************************************************************
C        ************************** WRITE TAPE *************************
C
 1300 IF (.NOT.TAPE) GO TO 1340
C        TAPE MUST BE TRUE ONLY ONCE, AT THE BEGINNING OF TAPE  WRITING.
C        WRITE HEADER STATION LABEL HERE.
      WRITE (8,1310) ISTA,WMONTH,KDTA
 1310 FORMAT (I5,A12,I6,17X)
      WRITE (8,1320) (D(J),T(J),S(J),SV(J),SIG(J),J=1,KDTA)
 1320 FORMAT (F6.2,2F6.3,F7.2,F7.4,8X)
C        LRECL WILL BE 40 DIGITS IN LENGTH. PROVIDE APPROPRIATE JCL.
      WRITE (6,1330) ISTA,WMONTH,JREC
 1330 FORMAT (5X,'DATA FOR STATION ',I5,A12,' WRITTEN ON TAPE UP TO
     1 RECORD ',I6)
C
C        ****************************************************************
C        ****************** DATA CARD PUNCH ROUTINE ******************
C
 1340 IF (.NOT.CARDS) GO TO 1430
C
C        PUNCHED DATA IS COMPRESSED BY FACTOR ICSQZ. FORMAT FOR TWO
C        DATA SETS ON A CARD.  KCRD BECOMES THE NUMBER OF DATA PRINTED IF
C        IT IS EVENLY DIVISIBLE. OTHERWISE, LAST DATUM POINT IS PUNCHED.
C        SUPPLY JCL FOR CARD PUNCHING
      KCRD = KDTA/ICSQZ
      NCRDS = KCRD/2
      IDIF = KCRD-2*NCRDS
      IF (IDIF.EQ.0) GO TO 1360
      KCRD = KCRD+1
 1350 FORMAT (24X,'OCEANOGRAPHIC DATA FROM U C M II',//)
 1360 WRITE (7,1350)
      WRITE (7,1370) KCRD,ISTA,WMONTH,ICSQZ
 1370 FORMAT (1X,I4,' VALUES OF D,T,S,SV,SIGMT FOR STATION ',I4,A12,
     1 '  COMPRESSED BY  ',I3,/)
 1380 FORMAT (2X,'DEPTH',3X,'TEMP.',1X,'SALNTY.',1X,'SND.VEL.',1X,
     1 'SIGMA-T',3X,'DEPTH',2X,'TEMP.',1X,'SALNTY.',1X,'SND.VEL.',1X,
     2 'SIGMA-T')
 1390 FORMAT (2X,'METERS',2X,'DEG.C.',1X,'PPT.',4X,'M/SEC',13X,'METERS',
```

```
    1 1X,'DEG.C.',1X,'PPT.',4X,'M/SEC',10X,/)
      WRITE (7,1380)
      WRITE (7,1390)
      ICS2 = ICSQZ*2
      J = 1
      K1 = 1
      KK = ICSQZ
 1400 FORMAT (1X,3F7.2,F9.2,F8.3,3X,3F7.2,F9.2,F8.3)
      WRITE (7,1400) D(K1),T(K1),S(K1),SV(K1),SIG(K1),D(KK),T(KK),S(KK),
     1SV(KK),SIG(KK)
      J = 3
 1410 IF (J.GT.NCRDS) GO TO 1420
      K1 = (J-1)*ICS2
      KK = K1+ICSQZ
      WRITE (7,1400) D(K1),T(K1),S(K1),SV(K1),SIG(K1),D(KK),T(KK),S(KK),
     1SV(KK),SIG(KK)
      J = J+1
      GO TO 1410
 1420 IF (IDIF.EQ.0) GO TO 1430
      K1 = KDTA
      WRITE (7,1400) D(K1),T(K1),S(K1),SV(K1),SIG(K1)
C
C      *****************************************************************
C      **************** HYDROGRAPHIC PROGRAM CARD PUNCH ****************
C
 1430 IF (.NOT.GCARDS) GO TO 1500
      GCRD = KDTA/IGSQZ
      WRITE (7,1350)
 1440 FORMAT (1X,I4,' VALUES OF D , T , AND S  FOR STATION ',I4,A12,
    1 '  COMPRESSED BY  ',I3,/)
      WRITE (7,1440) GCRD,ISTA,WMONTH,IGSQZ
 1450 FORMAT (2X,'DEPTH',7X,'TEMP.',4X,'SALINITY',15X,'STATION',4X,'DATE
    1',5X,'VALUE',9X)
 1460 FORMAT (2X,'METERS',6X,'DEG.C.',5X,'PPT.',51X,/)
      WRITE (7,1450)
      WRITE (7,1460)
      J = 1
      K1 = 1
 1470 FORMAT (1X,F7.1,2X,F9.2,1X,F10.3,18X,I3,A12,'  K1=',I4,I8)
      WRITE (7,1470) D(K1),T(K1),S(K1),ISTA,WMONTH,K1,J
      J = 2
 1480 K1 = (J-1)*IGSQZ
      IF (K1.GE.KDTA) GO TO 1490
      WRITE (7,1470) D(K1),T(K1),S(K1),ISTA,WMONTH,K1,J
      J = J+1
      IF (J.GE.500) GO TO 1500
      GO TO 1480
 1490 K1 = KDTA
```

```
      WRITE (7,1470) D(K1),T(K1),S(K1),ISTA,WMONTH,K1,J
C
C
C      ***************************************************************
C      JREC IS INCREMENTED HERE BY 1 TO ACCOUNT FOR TAPE ID LABEL FOR
C      NEXT STATION TO BE PROCESSED.  THIS KEEPS SERIALIZATION OF
C      RECORDS ON TAPE CONSECUTIVE AND INCLUDES LABELS FOR EACH STATION.
 1500 JREC = JREC+1
C      ***************************************************************
C
C
 1510 IF (ENDFL) END FILE 8
C
C      NORMALLY, ENDFL MUST BE TRUE ONCE ON THE LAST TAPE WRITING
C      OPERATION. HOWEVER, IT IS NOT REQUIRED BY IBM.  IT IS WRITTEN
C      ALWAYS AFTER LAST TAPE WRITING OPERATION WITHOUT COMMAND.
C
C      **************************************************************
C      ******** INITIALIZE VARIABLES AND ARRAYS FOR NEXT STATION *******
C
C
      DO 1520 J=1,1801
      D(J) = 0.0
      T(J) =-5.0
      S(J) = 0.0
      D2(J) = 0.0
      T2(J) =-5.0
      S2(J) = 0.0
      T1(J) =-5.0
      S1(J) = 0.0
      IREC(J) = 0
 1520 CONTINUE
C
C
      INSA(1) = 1
      INSA(2) = 1
      INTA(1) = 1
      INTA(2) = 1
      KBARF = 0
      KSCARF = 0
C
C
      DO 1530 J=3,10
      INSA(J) = 980
      INTA(J) = 980
 1530 CONTINUE
C
C
```

```
      KS = 1
      KT = 1
C
C
      DO 1540 J=1,50
      SH(J) = 0.0
      TH(J) =-5.0
      DH(J) = 0.0
 1540 CONTINUE
C
C
      SKIP = .FALSE.
      JSAV = 0
      KDTAF = 1
      IDEPTH = 0
      IH = 0
      IP = 0
      IF (NOIRG.EQ.1) GO TO 400
      GO TO 1570
C
C      ****************************************************************
C      ************************* R E T U R N ***************************
C
 1550 CONTINUE
 1560 FORMAT ('1')
 1570 IT = IT+1
      GO TO 150
 1580 STOP
      END
```

```
C      ----------------SUBROUTINE OUT1 MOD1,JUNE 1975--------------------
       SUBROUTINE OUT1 (D,T,S,SV,SIG,N,ISTA,WMONTH,IREC,JREC,ISQZ)
       REAL *8WMONTH
       DIMENSION D(1), T(1), S(1), SV(1), SIG(1), IREC(1)
C        PRODUCE HEADING
    20 WRITE (6,30) ISTA,WMONTH,ISQZ
    30 FORMAT (//T38,'OCEANOGRAPHIC DATA FROM U C M II'//T41,'STATION ',
      1 I3,A12/T41,'COMPRESSED BY FACTOR ',I3///)
C        FORMAT FOR PRINTING TWO BLOCKS OF DATA PER PAGE.
       WRITE (6,40)
    40 FORMAT (T6,'DEPTH',T14,'TEMP.',T20,'SALNTY.',T28,'SND.VEL.',T36,'
      1 SIGMA-T',T48,'DEPTH',T56,'TEMP.',T62,'SALNTY.',T70,'SND.VEL.',
      2 T80,'SIGMA-T')
       WRITE (6,50)
    50 FORMAT (T6,'METERS',T14,'DEG.C.',T21,'PPT.',T29,'M/SEC',T48,
      1 'METERS',T56,'DEG.C.',T63,'PPT.',T71,'M/SEC'/)
       NN = N/2
       NO = N-2*NN
C
C
       DO 60 J=1,NN,ISQZ
       K = NN+J
       WRITE (6,70) D(J),T(J),S(J),SV(J),SIG(J),D(K),T(K),S(K),SV(K),SIG(
      1K),IREC(J),IREC(K)
    60 CONTINUE
C
C
    70 FORMAT (T6,F5.1,T14,F5.2,T21,F5.2,T28,F7.2,T39,F6.3,T48,F5.1,T56,F
      15.2,T63,F5.2,T70,F7.2,T81,F6.3,T90,2I8)
       IF (NO.EQ.0) GO TO 90
       WRITE (6,80) D(N),T(N),S(N),SV(N),SIG(N),IREC(N)
    80 FORMAT (T48,F5.1,T56,F5.2,T63,F5.2,T70,F7.2,T81,F6.3,T90,8X,I8)
    90 WRITE (6,100)
   100 FORMAT ('1')
       RETURN
       END
```

```
C     ------------------------ SUBROUTINE CHMOVE -------------------------
      SUBROUTINE CHMOVE (A,I,B,J)
C      THIS SUBROUTINE RETURNS A LOGICAL*1 VARIABLE TO A 4-BYTE ADDRESS
C      IN THE MAIN PROGRAM, UNPACKING THE ORIGINAL 4-BYTE WORDS A
C      BYTE AT A TIME.
      LOGICAL *1A(1),B(1)
      B(J) = A(I)
      RETURN
      END
```

```
C        ----------------SUBROUTINE SVEL MOD.1,JUNE 73---------------
      SUBROUTINE SVEL (AA,BB,CC,SV,K1)
C      THIS COMPUTES SOUND VELOCITY FROM DEPTH, TEMPERATURE AND SALINITY
C      ACCORDING TO WILSON'S EQUATION
      DIMENSICN AA(1), BB(1), CC(1), SV(1)
C
C
      DO 30 J=1,K1
      Z = AA(J)
      T = BB(J)
      S = CC(J)
      IF (T.LT.-1.99.OR.S.LT.0.1) GO TO 20
      P = .1027*Z+1.282E-7*Z*Z
      T2 = T*T
      T3 = T2*T
      VT = 4.5721*T-4.4532E-2*T2-2.6045E-4*T3+7.9851E-6*T3*T
      P2 = P*P
      P3 = P2*P
      P4 = P2*P2
      VP = .160272*P+1.0268E-5*P2+3.5216E-9*P3-3.3603E-12*P4
      SR = S-35.
      VS = 1.39799*SR+1.69202E-3*SR*SR
      VSTP = SR*(-1.1244E-2*T+7.7711E-7*T2+7.7016E-5*P-1.2943E-7*P2+3.15
     180E-8*P*T+1.579E-9*P*T2)+P*(-1.8607E-4*T+7.4812E-6*T2+4.5283E-8*T3
     2)+P2*(-2.5294E-7*T+1.8563E-9*T2)+P3*(-1.9646E-10*T)
      SV(J) = 1449.14+VT+VP+VSTP+VS
      GC TO 30
   20 SV(J) = 0.
   30 CONTINUE
C
C
      RETURN
      END
```

```
C      ------------------------- SUBROUTINE SIGMT ----------------------
      SUBROUTINE SIGMT (AA,BB,SIG,K1)
C      THIS SUBROUTINE COMPUTES SIGMA-T FROM SALINITY AND
C      TEMPERATURE ACCORDING TO H.O.614 P.91
      DIMENSION AA(1), BB(1), SIG(1)
C
C
      DO 30 J=1,K1
      S = AA(J)
      T = BB(J)
      IF (T.LT.-1.99.OR.S.LT.0.1) GO TO 20
      CL = (S-0.03)/1.805
      B = T*(18.03-0.8164*T+0.01667*T**2)*10.**(-6)
      A = T*(4.7867-0.098185*T+0.0010843*T**2)*10.**(-3)
      SG = -0.069+1.4708*CL-0.001570*CL**2+0.0000398*CL**3
      SGA = -((T-3.98)**2/503.57)*((T+283)/(T+67.26))
      SIG(J) = SGA+(SG+0.1324)*(1-A+B*(SG-0.1324))
      GO TO 30
   20 SIG(J) = 0.
   30 CONTINUE
C
C
      RETURN
      END
```

```
C        ------------------------ SUBROUTINE CONDNS -------------------------
      SUBROUTINE CONDNS (X,Y,T1,JJJ,NE,KDT1,KDTH1,KDTH2)
C
C      SUBROUTINE CONDNS MOD. 3,17 SEPT 74  BY R. G. PAQUETTE.
C
C      THIS SUBROUTINE FINDS THE ARRAY LOCATIONS FOR X, INDEXED
C      SEQUENTIALLY FOR EACH UNIT OF Y.  EACH UNIT OF Y IS 1.0 AND
C      CORRESPONDS TO .01 INCHES OF TRAVEL IN THE DEPTH DIRECTION.
C      MOD. 3 FILLS IN BLANK ARRAY POSITIONS DUE TO THE DIGITIZER STEPP-
C      ING AHEAD MORE THAN .01 INCHES AT A STEP AND WRITES A MESSAGE
C      ON THE PRINTER.
      DIMENSION X(1), Y(1), T1(1), KINS(10), KNO(10)
C
C      IF FIRST INDEX IS ZERO OR NEGATIVE THERE IS A MISBEHAVIOR ELSE-
C      WHERE IN THE PROGRAM.  RESET JJJ TO 1.
      IF (JJJ.GE.1) GO TO 30
      JJJ = 1
      WRITE (6,20)
   20 FORMAT (/5X,'****** JJJ RESET TO ONE - SOMETHING WRONG ******'/)
C      KDTH1 BECOMES THE INDEX OF THE START OF THIS ARRAY SEGMENT.
   30 KDTH1 = Y(JJJ)+1.50
C      IF KDTH1 BECOMES ZERO OR LESS(THE ORIGIN OF MEASUREMENT IS
C      POSITIVE WITH RESPECT TO THE START OF TRACE), USE THE START
C      OF THE CURVE AS THE ORIGIN OF INDEXING.
C      THIS CAUSES AN OVERLAP BETWEEN ARRAYS, BUT IT SHOULD BE SMALL.
      XINC = 0.
      IF (KDTH1.GT.0) GO TO 40
      XINC = FLOAT(1-KDTH1)
      KDTH1 = 1
C
   40 JJ1 = JJJ+1
      NE1 = NE-1
C      FORM SUBSCRIPTS FROM THE DEPTH INCREMENTS AND STORE X'S AT THOSE
C      ARRAY LOCATIONS.
C      SEARCH FOR BLANKS IN ARRAY BETWEEN INDEXES KDTH1 AND KDTH2.
C      KCT COUNTS THE NUMBER OF BLANKS
      KCT = 0
      KSAV = KDTH1
C      KINS(J) IS THE NUMBER OF THE ARRAY POSITION FILLED.
C
C
      DO 50 J=1,10
      KNO(J) = 0
   50 KINS(J) = 0
C
C
C
C
```

```
      DO 80 J=JJ1,NE1
      KDTH = Y(J)+1.50+XINC
      T1(KDTH) = X(J)
C      TEST TO SEE IF INDEX IS THE SAME OR ONE GREATER THAN THE LAST
C      ONE.  IF NOT, INTERPOLATE VALUES.
      NREP = KDTH-KSAV
      IF (NREP.LE.1) GO TO 70
      KCT = KCT+1
      IF (KCT.GT.10) KCT = 10
      KNO(KCT) = NREP
      KINS(KCT) = KDTH
      II = KSAV+1
      III = KDTH-1
      E = FLOAT(NREP)
      G = T1(KDTH)
      F = G-T1(KSAV)
C
C
      DO 60 I=II,III
   60 T1(I) = (FLOAT(I-KSAV)/E)*F+T1(KSAV)
C
C
   70 KSAV = KDTH
   80 CONTINUE
C
C
      KDTH2 = Y(NE)+1.50+XINC
C      INSERT THE FIRST POINT, WHICH OTHERWISE WOULD BE THE LAST
C      ONE FOR WHICH Y(J).LT.1.
      T1(KDTH1) = X(JJJ)
      T1(KDTH2) = X(NE)
C      SAVE INDEX OF END OF ARRAY.
C
C
C      WRITE DOWN NUMBER AND LOCATIONS OF INTERPOLATED VALUES.
      WRITE (6,90) KCT,(KINS(I),I=1,KCT),(KNO(I),I=1,KCT)
   90 FORMAT (/5X,'BLANK ARRAY POSITIONS FILLED IN ',I3,' PLACES.  BEGIN
     1NING INDEXES AND NO. OF STEPS'/5X,'(10 EACH) ARE: ',5X,10I6/
     2 5X,10I6/)
      RETURN
      END
```

```
C     -------------------------- SUBROUTINE TPRD -------------------------
C     TPRD IS A MODIFIED VERSION OF TAPRD, WHICH ALLOWS THE USER TO
C     READ MAGNETIC TAPE RECORDS WHICH CANNOT BE READ BY STANDARD
C     METHODS. TPRD DIFFERS FROM TAPRD ONLY IN THAT IT ALLOWS
C     RECORDS TO BE SKIPPED. THIS IS ACCOMPLISHED BY ALTERING THE
C     FOLLOWING CARDS:
C
C        CARD NO.        TAPRD VERSION             TPRD VERSION
C
C        TPR01430        TAPRD   CSECT             TPRD   CSECT
C        TPR01910        MVI   TPCCW,X'3F'         MVI   TPCCW,X'37'
C        TPR02990        TAPRD   CSECT             TPRD   CSECT
C
C     OTHERWISE, THE PROGRAMS ARE IDENTICAL. A LISTING OF TPRD VERSION
C     MINUS THE DOCUMENTATION IS PROVIDED BELOW.  SEE W.R.CHURCH
C     COMPUTER CENTER LIBRARY FOR LISTING OF TAPRD AND APPLICABLE
C     DOCUMENTATION.
*    ..................................................................  TPR01300
*                                                                        TPR01310
          MACRO                                                          TPR01320
          REGS                                                           TPR01330
          LCLA   &N                                                      TPR01340
          LCLC   &SYM                                                    TPR01350
.LOOP     ANOP                                                           TPR01360
&SYM      SETC   '&N'                                                    TPR01370
R&SYM     EQU    &SYM                                                    TPR01380
&N        SETA   &N+1                                                    TPR01390
          AIF    (&N LT 16).LOOP                                         TPR01400
          MEND                                                           TPR01410
          SPACE 2                                                        TPR01420
TPRD     CSECT                                                           TPR01430
          SPACE 2                                                        TPR01440
          REGS                                                           TPR01450
          SPACE 2                                                        TPR01460
          STM    R14,R12,12(R13)                                         TPR01470
          LR   R12,R15                                                   TPR01480
          USING TPRD,R12                                                 TPR01490
          LA     R11,SAV1       LINK  SAVE REGISTERS                     TPR01500
          ST     R13,4(R11)                                              TPR01510
          ST     R11,8(R13)                                              TPR01520
          LR     R13,R11                                                 TPR01530
          LR     R11,R1          GET ADDRESS OF ARGUMENT LIST            TPR01540
          USING ARGS,R11                                                 TPR01550
          L      R10,AADD                                                TPR01560
          ST     R10,SHOVAAD     PUT IN LIST FOR SHOVE CALL              TPR01570
          L      R10,ALADD                                               TPR01580
          L      R10,0(R10)      PUT LENGTH IN SAME LIST                 TPR01590
          ST     R10,SHOVALN                                             TPR01600
```

```
         LA    R10,TPDCB
         USING IHADCB,R10
         TM    DCBOFLGS,X'10' HAS DCB BEEN OPENED?
         BO    OOKK         YES
         TM    BADBOMB,X'AA'  HAS THERE BEEN PREVIOUS CATASTROPHE?
         BNO   ONWITHIT       NOPE, GO AND OPEN IT
         SPACE 2
KIKIT    ABEND 3,DUMP         SHOULDNT EVER GET HERE, CRASH
         SPACE 2
ONWITHIT OPEN  (TPDCB,INPUT)
         TM    DCBOFLGS,X'10' DID STUPID THING OBEY?
         BNO   KIKIT           NOPE, GO PUNT
         L     R9,DCBDEBAD    GET POINTER AND DEVICE STATISTICS TABLE
         L     R9,32(R9)       GET UCB ADDR OUT OF DEB
         SR    R6,R6
         IC    R6,9(R9)       GET STAT TABLE POINTER
         MH    R6,=H'10'      POINTER * 10
         L     R9,16          POINTER TO CVT
         L     R9,112(R9)     POINTER TO STAT TABLE START
         LA    R9,0(R6,R9)     GOTCHA STAT TABLE
         ST    R9,STATTAB     SAVE ADDRESS OF STAT TABLE
         MVC   OLDSTAT,0(R9)   SAVE ITS INFO
         SPACE 2
OOKK     L     R0,SHOVALN  GET BLKSIZE FOR TAPE EXCP BUFFER
         STH   R0,BYTCNT      PUT DATA LENGTH INTO CCW
         L     R1,SHOVAAD
         ST    R1,TPBUFLOC
         MVC   TPBLOC,TPBUFLOC+1  PUT BUFFER LOC IN CCW
         LTR   R0,R0
         BP    OOKKK
         MVI   TPCCW,X'37'
         BAL   R9,TPGET
         MVI   TPCCW,X'02'
         BAL   R9,TPWAIT
         B     RETURN
         SPACE 2
         SPACE 2
OOKKK    BAL   R9,TPGET       GO READ A BUFFER
         SPACE 2
         BAL  R9,TPWAIT       GO WAIT TILL READ FINISHED
RETURN   LA    R15,0          NORMAL RETURN, MODIFIED ELSEWHERE
         L     R13,4(R13)     RESTORE REGISTERS
         L     R14,12(R13)
         LM    R0,R12,20(R13)
         BR    R14            ALL RETURNS THRU HERE
         SPACE 2
TPEOF    MVI   RETURN+3,X'04'  SET EOF RETURN
         SPACE 2
```

```
OUT      CLOSE TPDCB
         SPACE 2
         MVI   BADBOMB,X'AA'   TURN ON FLAG
         B     RETURN
         SPACE 2
GETSTAT  L     R9,STATTAB      ARRIVE HERE ON BAD READ
         MVC   NEWSTAT,0(R9)    GET CURRENT STAT TABLE
         L     R9,SHOVAAD      MOVE OLD AND NEW STAT TABLES TO FTN
         MVC   0(16,R9),OLDSTAT   ARRAY BEFORE ERROR RETURN
         MVI   RETURN+3,X'08'   SET I/O ERROR RETURN
         B     OUT
         SPACE 2
TPGET    MVI   TPECB,X'00'     CLEAR ECB
         MVC   TPEXCP,TPCCW
         MVI   RDFLG,X'FF'     TURN ON READ FLAG
         EXCP  TPIOB           DO IT
         BR    R9              RETURN
         SPACE 2
TPWAIT   TM    TPECB,X'40'     IS IT ALREADY DONE?
         BO    NOWAIT          YES
         WAIT  ECB=TPECB       NO,WAIT FOR IT
NOWAIT   CLI   TPECB,X'7F'     DID IT DO IT OK?
         BE    OK1             YES,CONTINUE
         SPACE 2
         CLI   TPCSW+3,X'0D' PROBABLE EOF IF CHAN-DEV END & UNIT EXCPT
         BNE   GETSTAT       NOPE, GO FIND ERROR
         CLI   FLAGS1,X'04'     EXCEPTIONAL CONDIT BIT ON? (=EOF)
         BNE   GETSTAT       NO EOF
         L     R1,DCBBLKCT      DECREMENT  DCBBLKCT SO IT MATCHES TAPE
         BCTR  R1,0                 TRAILER LABELS
         ST    R1,DCBBLKCT
         EOV   TPDCB         YES,EOF - FORCE CONTROL TO EODAD RTN
         SPACE 2
OK1      BR    R9               RETURN
         SPACE 2
SAV1     DC    18F'0'
         SPACE 2
OLDSTAT  DC    D'0'            COPY OF STAT TABLE AFTER OPEN
NEWSTAT  DC    D'0'            COPY OF STAT TABLE UPON ERROR
         SPACE 2
TPEXCP   DC    D'0'          LOC CONTAINING CCW BEING USED
TPCCW    DC    X'02'           READ
TPBLOC   DC    AL3(0)          DATA ADDRESS
FLGS     DC    X'20'           SUPPRESS INCORRECT LNGT
BYTCNT   DC    H'0'            BYTE COUNT
         SPACE 2
SHOVSMF  DC    A(0)            LOC OF SMF INFO
SHOVAAD  DC    A(0)            ADDR OF FORTRAN ARRAY
```

```
SHOVALN  DC    F'0'                 BYTE LENGTH OF FORTRAN ARRAY             TPR02570
         SPACE 2                                                             TPR02580
TPBUFLOC DC    A(0)                 LOC OF DCBBLKSI LENGTH TAPE BUFFER       TPR02590
         SPACE 2                                                             TPR02600
STATTAB  DC    A(0)                 LOC OF STAT TABLE                        TPR02610
         SPACE 2                                                             TPR02620
         SPACE 2                                                             TPR02630
RDFLG    DC    X'00'                 =X'FF' AFTER READ, BEFORE WAIT          TPR02640
BADBOMB  DC    X'00'                FLAG TO TELL WHETHER DCB USED BEFORE     TPR02650
         SPACE 2                                                             TPR02660
TPDCB    DCB   DDNAME=METTAP,MACRF=(E),EODAD=TPEOF,DSORG=PS,                *TPR02670
               IOBAD=TPIOB,DEVD=TA                                           TPR02680
         SPACE 2                                                             TPR02690
         DS    0F                                                            TPR02700
TPIOB    DS    0CL32                                                         TPR02710
FLAGS1   DC    X'00'                                                         TPR02720
FALGS2   DC    X'00'                                                         TPR02730
SENSE1   DC    X'00'                                                         TPR02740
SENS2   DC    X'00'                                                          TPR02750
ECBCOD   DC    X'00'                                                         TPR02760
ECBADD   DC    AL3(TPECB)                                                    TPR02770
FALGS3   DC    X'00'                                                         TPR02780
TPCSW   DC    7X'00'                                                         TPR02790
SIOCODE  DC    X'00'                                                         TPR02800
EXCPADD  DC    AL3(TPEXCP)                                                   TPR02810
RESERC   DC    X'00'                                                         TPR02820
DCBADDR  DC    AL3(TPDCB)                                                    TPR02830
REPOMOD  DC    X'00'                                                         TPR02840
RESTADR  DC    AL3(0)                                                        TPR02850
BLCINC  DC    H'1'                                                           TPR02860
ERORCNT  DC    H'0'                                                          TPR02870
         SPACE 2                                                             TPR02880
TPECB    DC    F'0'                                                          TPR02890
         SPACE 2                                                             TPR02900
ARGS     DSECT                                                               TPR02910
AADD     DC    A(0)                 ADDRESS OF FORTRAN ARRAY                 TPR02920
ALADD    DC    A(0)                 ADDRESS OF LENGTH OF FORTRAN ARRAY       TPR02930
         SPACE 2                                                             TPR02940
         PRINT NOGEN                                                         TPR02950
         DCBD  DSORG=PS,DEVD=TA                                              TPR02960
         PRINT GEN                                                           TPR02970
         SPACE 2                                                             TPR02980
TPRD    CSECT                                                                TPR02990
        LTORG                                                                TPR03000
         END                                                                 TPR03010
```

A P P E N D I X   B

```
C TITLE          DIGIXBT
C
C
C PROGRAMERS     R.E.BLUMBERG, R.E. GREER. ADAPTED FROM DIGISTD PROGRAM
C                 WHICH WAS AN EXTENSIVE MODIFICATION OF AN ORIGINAL
C                 PROGRAM, MIZ2, BY R.G. PAQUETTE.
C
C DOCUMENTATION  R.E.BLUMBERG
C
C DATE           26 JUNE 1975
C
C PURPOSE        PROGRAM READS AND PROCESSES DIGITIZED TEMPERATURE,AND
C                 DEPTH DATA FROM A CALMA DIGITIZER 7-TRACK TAPE.THE
C                 DATA IS COMPUTED AND STORED FOR EVERY 0.01 OF AN INCH
C                 OF DEPTH INCREMENT ON THE XBT TRACE. PROGRAM COMPUTES
C                 DEPTH AND TEMPERATURE FOR EACH INDIVIDUAL
C                 OCEANOGRAPHIC STATION AND PERMITS PRINTED, PUNCHED
C                 CARD OR 9-TRACK TAPE OUTPUT. NOTE, THIS PROGRAM IS
C                 SET UP TO PROCESS WATER TEMPS BETWEEN 1 AND 25 DEGREES
C                 CELSIUS.
C
C SEQUENCE       THE PROGRAM PERFORMS THESE FUNCTIONS IN THE FOLLOWING
C                 SEQUENCE:
C                   (A) INITIALIZES ALL ARRAYS AND VARIABLES
C                   (B) SKIPS XXX NUMBER OF RECORDS IF NSKP=GREATER THAN
C                     ZERO.
C                   (C) READ PAIR OF DATA CARDS (LABEL AND DAT) FOR
C                     RECORD BEING PROCESSED. COUNT RECORDS.
C                   (D) PROGRAM TERMINATES IF ISTOP=1 OR DESIRED NUMBER
C                     OF RECORDS PROCESSED.
C                   (E) HEADER INFO MISSING ON TAPE, INSERT ON CARDS BY
C                     SETTING IHDR=1.
C                   (F) SKIP UNREADABLE OR BAD RECORD IF NRCSKP SET
C                     EQUAL TO THE BAD RECORD NUMBER.
C                   (G) READ USABLE RECORD INTO THE A ARRAY
C                   (H) MOVE BYTES OF A ARRAY INTO 4-BYTE WORDS OF B
C                     ARRAY TO ALLOW PROCESSING BY STANDARD FORTRAN.
C                   (I) PROCESS RAW B ARRAY
C                     (1) IF HEADER RECORD, PROGRAM DECODES HEADER
C                       LABEL AND COMPARES TO LABEL SUPPLIED BY DATA
C                       CARD.
C                     (2) IF TRACER RECORD, PROGRAM ADDS AND STORES
C                       CUMULATIVE SUMS OF X AND Y DISTANCE TRAVEL.
C                       SUBROUTINE CONDNS INDEXES THE VALUES OF
```

```
C                          CUMULATIVE DISTANCE BY INCREASING DEPTH UNITS.
C                     (J) CONVERT THE X AND Y ARRAYS TO DEPTH AND
C                        TEMPERATURE.
C                     (K) MANUALLY INSERT SURFACE AND NEAR SURFACE VALUES
C                        VIA DATA CARDS.
C                     (L) ELIMINATE EXCESSIVELY HIGH OR LOW VALUES.
C                     (M) COMPUTE CONSECUTIVE RECORD SERIALIZATION FOR
C                        TAPE OUTPUT NUMBERING SCHEME.
C                     (N) CONVERTS LETTER DESIGNATOR MONTH/YEAR CODE,
C                        AMONC, TO REAL*8 MONTH AND YEAR.
C                     (O) DATA OUTPUT IN EITHER REGULAR PRINTOUT, TAPE, OR
C                        PUNCHED CARDS. CARD OUTPUT SUITABLE FOR THESIS1.
C                     (P) INITIALIZE ARRAYS AND VARIABLES FOR PROCESSING
C                        NEXT STATION'S DATA.
C                     (Q) REPEAT STEPS (C) THRU (P) UNTIL ALL RECORDS ARE
C                        PROCESSED, ISTOP=1, OR THE NUMBER OF DESIRED
C                        RECORDS (NN) ARE READ.
C
C FEATURES          THIS IS A HIGHLY VERSATILE PROGRAM FOR PROCESSING
C                     OCEANOGRAPHIC DATA FROM 7-TRACK TAPE. FEATURES OF THE
C                     PROGRAM ARE LISTED UNDER THE FOLLOWING SIX GENERAL
C                     CATEGORIES:
C                      (A) INPUT
C                         (1) 7-TRACK CALMA DIGITIZER TAPE IN BCD.
C                         (2) TWO DATA CARDS REQUIRED PER TRACE SEGMENT
C                           RECORD OR HEADER LABEL RECORD. AN XBT TRACE
C                           REQUIRES 4 CARDS, ONE PAIR FOR THE HEADER AND
C                           ONE PAIR FOR THE TRACE. THE FOLLOWING IS A
C                           SAMPLE DATA DECK SHOWING DATA CARDS FOR STATION
C                           207 AND 208. ALSO SHOWN IS THE 'STATION END'
C                           CARD WITH ISTOP SET EQUAL TO ONE. THIS IS
C                           FOLLOWED BY THE JCL NECESSARY TO READ THE 7-
C                           TRACK TAPE.COLUMN 1 IS BLANK ON THE DATA CARDS.
C       &CONTRL NN=104,IDSCL=1,ICODE=0,ITSCL=1,ISCL=1,IP=1,ISQZ=01,
C       ICSQZ=3,TAPE=F,CARDS=F,TCOR=-.13,XBTCOR=0.0,NSKP=6,&END
C           UCMXBT STATIONS 201V THRU 317V TAPE UCM011
C           HEADER XBT
C       &DAT  IDEPTH=99,ISTA=207,AMONC='V',&END
C           TRACER XBT                                                V
C       &DAT  IDEPTH=00,DH=0.0,TH=12.12,IH=1,&END
C           HEADER XBT
C       &DAT  IDEPTH=99,ISTA=208,AMONC='V',&END
C           TRACER XBT                                                V
C       &DAT  IDEPTH=00,&END
C            STATION END                                             1
C      //GO.METTAP DD UNIT=2400-1,VOL=SER=UCM011,DISP=OLD,LABEL=(,NL),
C      //        DCB=(DEN=1,TRTCH=ET)
C                     (B) SUBROUTINES
```

```
C                   (1) TPRD-READS THE 7-TRACK MAGNETIC TAPE.
C                   (2) CHMOVE- TAKES THE DATA THAT HAS BEEN READ
C                     INTO THE A ARRAY AND STORES IT IN USABLE FORM
C                     IN THE B ARRAY.
C                   (3) CONDNS- INDEXES THE VALUES OF CUMULATIVE
C                     DISTANCE BY INCREASING DEPTH UNITS.
C                   (4) OUT2- PRINTS OUT OCEANOGRAPHIC STATION DATA.
C                 (C) AUTOMATIC DATA PROCESSING/HANDLING
C                   (1) HANDLES OPERATOR MISTAKES MADE IN TRACING XBT
C                     CURVES ON CALMA DIGITIZER.
C                   (2) SKIPS INITIAL NUMBER AND INDIVIDUAL BAD
C                     RECORDS ON 7-TRACK TAPE.
C                   (3) DECODES 7-TRACK TAPE HEADER LABELS AND TRACE
C                    RECORDS.
C                   (4) COMPUTES DATA FOR EVERY 0.01 INCH OF CALMA
C                     DIGITIZER STYLUS MOVEMENT.
C                   (5) ALLOWS ENTRY OF HAND ENTERED DATA FOR
C                     SURFACE AND NEAR SURFACE VALUES.
C                   (6) EDITS OUT EXCESSIVELY LOW & HIGH VALUES.
C                   (7) PROVIDES CONSECUTIVE RECORD SERIALIZATION
C                     FOR TAPE OUTPUT.
C                 (D) DIAGNOSTICS
C                   (1) WRITES FIRST TWENTY FIVE VALUES OF DEPTH AND
C                     TEMPERATURE FOR DATA INSPECTION.
C                 (E) TROUBLE-SHOOTING
C                   (1) HANDLES MULTIPLE KEYBOARD AND TRACER SYMBOL
C                     ENTRIES.
C                   (2) PROVIDES FOR A MISSED OR INCOMPLETE HEADER
C                     LABEL.
C                   (3) HANDLES MISSING INTER-RECORD GAP (IRG).
C                   (4) HANDLES DELETE RECORD BY INCREMENTING RECORD
C                     COUNT AND READING SAME PAIR OF CARDS AGAIN.
C                   (5) COMPARES CARD HEADER LABEL AND TAPE HEADER
C                     LABEL AND ACCEPTS CARD VALUES IF CARD AND TAPE
C                     DISAGREE.
C                 (F) OUTPUT
C                   (1) PRINTER- TWO PRINTING VARIABLES, PRT1 AND
C                     PRT2. PRT2 PROVISION ONLY.
C                   (2) CARD-PUNCHED DATA CARDS SUITABLE FOR USE WITH
C                     THESIS1.
C                   (3) TAPE- 9-TRACK TAPE
C                   (4) PLOTTING- PROVISION FOR PLOTTING ROUTINES
C                     ACTUATED BY PLT1 AND PLT2 ARE NOT PRESENTLY
C                     PROGRAMMED.
C
C ARGUMENTS     PROGRAM CONSISTS OF MANY TERMS,ARRAYS,AND VARIABLES.
C                 SOME OF THESE VARIABLES ARE USED IN THE DIGISTD
C                 PROGRAM. THEY WERE INCLUDED IN THIS PROGRAM TO KEEP
```

```
C                     THE HEADER LABEL PROCESSING ON THE CALMA DIGITIZER
C                     THE SAME FOR BOTH STD AND XBT TRACES. THESE VARIABLES
C                     ARE IDENTIFIED BELOW AND ARE SET EQUAL TO A CONSTANT
C                     IN THIS PROGRAM.
C                     THE FOLLOWING IS A BRIEF DESCRIPTION OF THE
C                     IMPORTANT ARGUMENTS LISTED ALPHABETICALLY UNDER TWO
C                     GENERAL CATEGORIES:
C
C                      (A) ARRAYS
C                         D,T      = DEPTH,TEMPERATURE
C                         DH,TH    = HAND-ENTERED SURFACE OR NEAR SURFACE
C                                    DATA
C                         X,Y      = CUMULATIVE SUMS OF DISTANCE TRAVELED BY
C                                    THE DIGITIZER STYLUS. STORAGE IS
C                                    PROVIDED FOR 20 INCHES TOTAL TRAVEL
C                                    OF THE STYLUS ON EACH COORDINATE
C                                    AXIS. THIS INCLUDES BOTH PLUS AND MINUS
C                                    DIRECTIONS.
C                         NRCSKP   = NUMBER OF THE INDIVIDUAL RECORD SKIPPED
C                         DCON     = DEPTH CONSTANT  NUMBER OF 0.01 INCHES
C                                    PER UNIT OF DEPTH.
C                         IREC     = CONSECUTIVE SERIAL RECORD NUMBER FOR
C                                    TAPE
C                         AMONCA   = MONTH/YEAR CODE LETTER.
C                         EVENT    = MONTH AND YEAR.
C
C                      (B) VARIABLES
C                         CARDS    = PERMITS PUNCHING CARDS
C                         CONTRL   = NAMELIST VARIABLE USED FOR INFREQUENTLY
C                                    CHANGED VARIABLES.
C                         DCOR     = DEPTH CORRECTION TERM.
C                         DAT      = NAMELIST VARIABLE USED FOR
C                                    FREQUENTLY CHANGED VARIABLES.
C                         DLTREC   = DELETE RECORD
C                         FLAG     = INDICATES START OF DATA TRACE.
C                         ICODE    = VARIABLE HELD OVER FROM DIGISTD
C                                    ICODE IS A CONSTANT = ZERO.
C                         ICSQZ    = VARIABLE USED TO COMPRESS NUMBER OF
C                                    DATA POINTS PUNCHED ON CARDS.
C                         IDENT    = VARIABLE USED TO IDENTIFY HEADER
C                                    LABEL, (IDENT =99) OR TRACE RECORD
C                                    (IDENT = 00).
C                         IDSCL    = VARIABLE HELDOVER FROM DIGISTD PROGRAM
C                                    IDSCL IS A CONSTANT = 1.
C                         IH       = NUMBER OF HAND ENTERED SURFACE OR
C                                    NEAR-SURFACE DATA VALUES.
C                         IHDR     = VARIABLE USED TO IDENTIFY MISSED HEADER
C                                    LABEL ON TAPE. ALLOWS MISSING INFO TO BE
```

```
C                               INSERTED ON CARDS.
C                   IP       = VARIABLE IDENTIFIES LAST RECORD OF
C                              PARTICULAR STATION. SINCE XBT IS A
C                              SINGLE TRACE IP IS A CONSTANT = 1.
C                   ISCL     = VARIABLE HELD OVER FROM DIGISTD
C                              PROGRAM ISCL IS A CONSTANT = 1.
C                   ISQZ     = VARIABLE USED TO COMPRESS NUMBER
C                              OF DATA POINTS PRINTED BY PRINTER.
C                   ISTA     = VARIABLE IDENTIFIES STATION NUMBER.
C                   ISTOP    = VARIABLE TERMINATES PROGRAM IF = 1 ON
C                              FINAL &DAT CARD.
C                   ITSCL    = VARIABLE HELDOVER FROM DIGISTD PROGRAM
C                              ITSCL IS A CONSTANT = 1.
C                   JREC     = VARIABLE USED TO COUNT RECORDS FOR
C                              RECORD SERIALIZATION PURPOSES.
C                   JSKIP    = VARIABLE USED TO CONTRL NUMBER OF
C                              DATA CARDS READ.
C                   KEY      = KEYBOARD SYMBOL ON THE DIGITIZED TAPE.
C                   KDTH2    = NUMBER OF RECORD PROCESSED FOR
C                              PARTICULAR STATION.
C                   LABEL    = HEADER TYPE DATA CARD WHICH
C                              IDENTIFIES STATION NUMBER, MONTH, ETC.
C                   NCRDS    = NUMBER OF CARDS PUNCHED BY CARDS
C                              PUNCHING ROUTINE.
C                   NE       = AN INDEX AT THE LAST USEFUL ARRAY
C                              POSITION OF THE X(DEPTH) ARRAY.
C                   NOIRG    = VARIABLE USED TO INDICATE MISSING
C                              END OF RECORD GAP ON TAPE.
C                   NPTS     = NUMBER OF DATA POINTS TO BE PUNCHED
C                              BY CARDS PUNCHING ROUTINE.
C                   NSKP     = NUMBER OF INITIAL RECORDS ON TAPE
C                              TO BE SKIPPED
C                   TCOR     = CORRECTION FACTOR ADDED TO
C                              TEMPERATURE DATA VALUES.
C                   WMONTH   = REAL*8 -MONTH AND YEAR
C       ----------------------- SUBROUTINE TPRD -----------------------
C       TPRD IS IN ASSEMBLER LANGUAGE AND REQUIRES SPECIAL JCL.
C       THE COMMENT CARDS ARE INCLUDED HERE BECAUSE NO COMMENT CARDS ARE
C       ALLOWED TO BE MIXED WITH THE ASSEMBLER LANGUAGE SUBROUTINE.
C       A  /*  FOLLOWED BY A  //ASM.SYSIN DD *  MUST PRECEDE THE DECK.
C       THIS DECK IS RUN UNDER // EXEC FORTCALG.
C       TPRD IS A MODIFIED VERSION OF TAPRD, WHICH ALLOWS THE USER TO
C       READ MAGNETIC TAPE RECORDS WHICH CANNOT BE READ BY STANDARD
C       METHODS. TPRD DIFFERS FROM TAPRD ONLY IN THAT IT ALLOWS
C       RECORDS TO BE SKIPPED. THIS IS ACCOMPLISHED BY ALTERING THE
C       FOLLOWING CARDS:
C
C           CARD NO.        TAPRD VERSION             TPRD VERSION
```

```
C
C        TPRO1430        TAPRD   CSECT            TPRD   CSECT
C        TPRO1910        MVI   TPCCW,X'3F'        MVI   TPCCW,X'37'
C        TPRO2990        TAPRD   CSECT      .     TPRD   CSECT
C
C     OTHERWISE, THE PROGRAMS ARE IDENTICAL. A LISTING OF TPRD VERSION
C     MINUS THE DOCUMENTATION IS PROVIDED BELOW.  SEE W.R.CHURCH
C     COMPUTER CENTER LIBRARY FOR LISTING OF TAPRD AND APPLICABLE
C     DOCUMENTATION.
C
      DIMENSION X(4001), Y(4001), LABEL(19), TH(12), DH(12), IREC(1801),
     1 NRCSKP(99), DCON(1), AMONCA(13), EVENT(13), D(1801), T(1801)
      INTEGER B(8001),ZER,DOL,STAR,ONE,FLAG,DLTREC,DLR,BLANK,A(2001),TWO
     1,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,TEN,ELEVEN,AMONT
      LOGICAL PRT1,PRT2,PLT1,PLT2,TAPE,ENDFL,CARDS,SKIP
C     ******************************************************************
C
      NAMELIST /CONTRL/ NN,PRT1,PRT2,PLT1,PLT2,TAPE,ENDFL,CARDS,ISTOP,IP
     1,IH,NRCSKP,NSKP,JSKIP,ISQZ,IDSCL,ICODE,ITSCL,ISCL,XBTCOR,ICSQZ,TCO
     2R/DAT/TH,DH,IH,ICODE,ISCL,ITSCL,IDSCL,IP,IDEN,ISQZ,ITSQZ,ICSQZ,TCO
     3R,IHDR,NOIRG,CARDS,ISTA,DCON,DCOR,SKIP,AMONC,TAPE
C
C     ******************************************************************
C
      REAL *8EVENT,WMONTH
      DATA AMONCA/'H','I','C','K','L','O','P','Q','R','U','V','W','Z'/
      DATA EVENT/'AUG 1973','SEP 1973','OCT 1973','NOV 1973','DEC 1973',
     1'JAN 1974','FEB 1974','MAR 1974','APR 1974','MAY 1974','JUN 1974',
     2'JUL 1974','AUG 1974'/
C
C     DEFINE SYMBOLS, NOTEING THAT THE LEFT THREE HEX BYTES IN EACH
C     ELEMENT OF B END UP FILLED WITH BLANKS
      DATA DOL/'$$$$'/,STAR/Z4040405C/,KEY/Z4040405F/,ONE/Z404040F1/,
     1FLAG/Z40404050/,DLTREC/Z40404060/,MINUS/Z40404061/,
     2 DLR/Z4040405B/,BLANK/'    '/,ZER/Z404040F0/,TWO/Z404040F2/,
     3THREE/Z404040F3/,FOUR/Z404040F4/,FIVE/Z404040F5/,
     4MTWO/Z404040E2/,MTHREE/Z404040E3/,MFOUR/Z404040E4/,MFIVE/Z404040E5
     5/,SIX/Z404040F6/,SEVEN/Z404040F7/,EIGHT/Z404040F8/,NINE/Z404040F9
     6/,TEN/Z404040F0/,ELEVEN/Z4040407B/
C
C     ******************************************************************
C***(A) INITIALIZE VARIABLES AND ARRAYS.********************************
C
C     THE FOLLOWING CONVERSION FACTOR IS IN HUNDREDS OF INCHES PER
C     UNIT OF T. IT MAY BE OVERRIDDEN BY THE DATA CARDS.
      DCON(1) = 1.0475
C
      DATA CARDS/.FALSE./,DCOR/0.0/,ENDFL/.FALSE./,FG/0./,ICODE/0/,ICSQZ
```

```
     1/1/,IDSCL/1/,IH/0/,IHDR/0/,IP/0/,IPS/8000/,ISCL/1/,ISQZ/1/,ISTOP/0
     2/,ITSCL/1/,ITSQZ/1/,JJJ/0/,JJJJ/0/,JREC/1/,JSAV/0/,KDTH1/1/,KDTH2/
     31/,NE/0/,NOIRG/0/,NSKP/0/,PLT1/.FALSE./,PLT2/.FALSE./,PRT1/.TRUE./
     4,PRT2/.FALSE./,SKIP/.FALSE./,TAPE/.FALSE./,TCOR/0./
C
C        GIVE THE ARRAYS INITIAL VALUES
C
C
C
      DO 20 J=1,12
      TH(J) = 0.
      DH(J) = 0.
   20 CONTINUE
C
C
C
C
      DO 30 J=1,1801
      D(J) = 0.
      T(J) = 0.
   30 CONTINUE
C
C
C
C
      DO 40 J=1,99
      NRCSKP(J) = 0
   40 CONTINUE
C
C
C
      READ (5,CONTRL)
      READ (5,140) LABEL
      WRITE (6,150) LABEL
C      REWIND HERE IF TAPE IS USED. NOTE THAT IF TAPE=T,JCL
C      MUST BE PROVIDED TO DEFINE IT.
      IF (TAPE) REWIND 8
      IF (NSKP.EQ.0) GO TO 110
C
C        ******************************************************************
C***(B) SKIP RECORDS.*******************************************************
C
C        NOTE: THE PROGRAM DIFFERENTIATES BETWEEN INITIALLY SKIPPED
C        RECORDS (NSKP) AND BAD RECORDS (NRCSKP).  NRCSKP
C        REQUIRES DATA CARDS FOR BAD RECORDS SKIPPED AND NSKP
C        DOESN'T. PLUS NRCSKP ONLY SKIPS A SINGLE RECORD FOR EACH
C        VALUE ASSIGNED TO NRCSKP, WHEREAS NSKP SKIPS MULTIPLE
C        RECORDS (IE. NSKP=40, THE FIRST 40 RECORDS ON THE TAPE
```

```
C       WILL BE SKIPPED.) NSKP
C       AS WELL AS THE 10 VALUES OF NRCSKP MUST BE ON THE FIRST
C       CONTRL CARD ONLY. A SINGLE CONTRL CARD IS READ HERE AT THE
C       START TO SET NSKP AND NRCSKP.
C
C
C
C
      DO 50 IS=1,NSKP
      IIS = IS
C       IPS IS SET NEGATIVE DURING THE SKIP PROCESS. THIS AVOIDS TPRD
C       STOPPING ON UNREADABLE RECORDS. IPS IS THE MAXIMUM NUMBER OF
C       BYTES OF DATA WHICH WILL BE READ FROM ONE RECORD OF DIGITIZER
C       TAPE BY TPRD. IPS/2 IS THE MAXIMUM TOTAL TRAVEL ALONG THE CURVE
C       MEASURED IN HUNDREDTHS OF AN INCH IN THE X AND Y DIRECTIONS
C       SEPARATELY. NO DATA CARDS ARE NEEDED FOR SKIPPED RECORDS.
      IPS = -8000
   50 CALL TPRD (A,IPS,&70,&90)
C
C
C
C       RESET IPS FOR NORMAL TAPE READING
      IPS = 8000
      WRITE (6,60) IIS
   60 FORMAT (/5X,I5,' RECORDS SKIPPED'/)
      GO TO 110
C
C       END AND ERROR MESSAGES.  PROGRAM STOPS
   70 WRITE (6,80) IIS
   80 FORMAT (/5X,'FOUND END OF FILE ON RECORD',I4,'DURING SKIP PROCESS'
     1 /)
      GO TO 1370
   90 WRITE (6,100) IIS,A(1),A(2),A(3),A(4)
  100 FORMAT (/5X,'READ ERROR ON RECORD',I5,'ERROR STATISTICS ARE: ',4Z8
     1)
      GO TO 1370
C
C       REDEFINE LOOP INDEX TO START AT ONE.
  110 NNN = NN-NSKP
C
C       *****************************************************************
C***(C) READ CARDS AND START MAIN LOOP. COUNT RECORDS.*******************
C       *****************************************************************
C***(D) TERMINATE PROGRAM IF ISTOP=1 OR NUMBER OF RECORDS PROCESSED.****
C
      IT = 1
  120 IF (IT.GT.NNN) GO TO 1370
      IPS = 8000
```

```
      NREC = IT+NSKP
      WRITE (6,130) NREC
  130 FORMAT (/5X,'LABEL 130 ; START MAIN LOOP.  RECORD NO. ',I3/)
C      THE NUMBER OF RECORDS TREATED IS DETERMINED BY SETTING
C      NN= NUMBER OF RECORDS ON THE CONTRL CARD. OR THE PROGRAM MAY
C      BE STOPPED BY SETTING ISTOP.GT.0 ON THE LABEL CARD.
C      THE LABEL CARD HAS THE LAST FOUR COLUMNS FOR CONTROL ALTHOUGH
C      ONLY THREE ARE USED HERE. THE 77-TH COLUMN IS JSKIP; IF IT
C      IS ZERO, ONLY TWO CARDS ARE READ. IF IT IS 1 AN ADDITIONAL CARD,
C      AN &CCNTRL CARD, CAN ALSO BE READ. THE 78-TH COLUMN IS ISTOP;
C      IF IT IS =1 THE PROGRAM STOPS. THE 79-TH COLUMN IS AMONC;
C      IT IS AN ALPHABETIC CHARACTER THAT DESIGNATES THE MONTH
C      IN WHICH THE DATA WERE TAKEN. NOTE THAT THIS NEEDS TO BE
C      ON THE LAST CARD SET READ BEFORE PRINTING. AMONC MAY ALTERNATELY
C      BE ADDED ON THE &DAT HEADER CARD.
      READ (5,140) LABEL,JSKIP,ISTOP,AMONC
  140 FORMAT (19A4,2I1,A1)
      IF (ISTOP.GT.0) GO TO 1370
      READ (5,DAT)
      WRITE (6,150) LABEL
      WRITE (6,DAT)
C      NORMALLY TWO DATA CARDS ARE EXPECTED TO BE READ PER RECORD,
C      LABEL AND DAT.  LESS FREQUENTLY CHANGED NUMBERS ARE ON CONTRL.
      JJJJ = 0
      NOIRG = 0
      IF (JSKIP.EQ.0) GO TO 160
      READ (5,CONTRL)
      WRITE (6,CONTRL)
  150 FORMAT (/5X,19A4/)
C
C      ****************************************************************
C***(E) HEADER INFO MISSING.*******************************************
C
C      IHDR=1 ON &DAT PROVIDES FOR MISSED HEADER INSERT ALL THE
C      HEADER INFO ON CARDS, BRANCH TO 540 AND THEN RETURN TO START AT
C      120 WITHOUT INCREMENTING THE RECORD COUNT.
  160 IF (IHDR.EQ.1) GO TO 540
  170 CONTINUE
C
C      DIAGNOSTIC WRITE STATEMENTS FOLLOW:
C
  180 FORMAT (5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.2/5X,11F7.
     12/5X,11F7.2/5X,11F7.2/5X,3F7.2,60X,I6)
  190 FORMAT (7X,' JJJ,  NE  ,KDTH1,KDTH2,JJJJ'/4X,5I6)
      IPLACE = 170
      WRITE (6,180) (D(J),J=1,1801,20),IPLACE
      WRITE (6,180) (T(J),J=1,1801,20),IPLACE
      WRITE (6,190) JJJ,NE,KDTH1,KDTH2,JJJJ
```

```
C--------------------
C
C      FILL THE A ARRAY WITH DOLLARS
C
C
C
      DO 200 I=1,2001
C      THE 2001 ASSURES THAT THE LAST WORD OF A WILL CONTAIN DOLLARS
C      SINCE WE READ IN ONLY 8000 BYTES OF DATA.
  200 A(I) = DOL
C
C
C
C      FILL B WITH BLANKS
C
C
C
      DO 210 I=1,8000
  210 B(I) = BLANK
C
C
C
C      ***********************************************************
C***(F) SKIP BAD RECORDS.******************************************
C
C      THE LIST OF BAD RECORDS IS EXAMINED AND SKIPPED.
C      DO NOT REMOVE THE DATA CARDS FOR THE BAD RECORD.
C      NOTE THAT IF NRCSKP(1) IS ZERO, THE TEST IS SKIPPED.
      IF (NRCSKP(1).EQ.0) GO TO 250
C
C
C
      DO 220 J=1,99
      NRC = NRCSKP(J)-NSKP
      IF (NRC.EQ.IT) GO TO 230
  220 CONTINUE
C
C
C
      GO TO 250
C      CHANGING IPS TO NEGATIVE CAUSES TPRD TO SKIP A RECORD
  230 IPS = -8000
  240 FORMAT (//5X,'LABEL 240. RECORD NO.',I5,' SKIPPED VIA NRCSKP SKIP
     1 ROUTINE.'//)
      WRITE (6,240) IT
C
C      ***********************************************************
C***(G) READ USABLE RECORD INTO A ARRAY.****************************
```

```
C
  250 CALL TPRD (A,IPS,&280,&260)
C
C       IPS IS THE MAXIMUM SIZE OF THE ORIGINAL BCD RECORD. THIS SIZE
C       / 200 IS THE MAXIMUM DISTANCE THE STYLUS CAN TRAVEL, + AND/OR -,
C       IN EITHER THE X OR THE Y DIRECTION; 60 IS THE END-OF-FILE EXIT,
C        2 IS THE READ-ERROR EXIT.
      GO TO 290
  260 WRITE (6,270) A(1),A(2),A(3),A(4)
  270 FORMAT (5X,'THE ERROR STATISTICS TABLE IS ',4Z8)
  280 CONTINUE
  290 CONTINUE
C
C       ***************************************************************
C***(H) MOVE BYTES OF A ARRAY INTO B ARRAY.*****************************
C
      JJ = 0
      JJJ = 0
C
C
C
      DO 300 II=1,2000
C
C
C
      DO 300 I=1,4
      JJ = JJ+1
      CALL CHMOVE (A(II),I,B(JJ),4)
      IF (B(JJ).EQ.DLR) GO TO 310
C       END OF DATA DETECTED
  300 CONTINUE
C
C
  310 CONTINUE
C
C
      B(8001) = DLR
C
C       ***************************************************************
C***(I) PROCESS B ARRAY.***********************************************
C
C       A DIAGNOSTIC WRITE STATEMENT FOLLOWS:
      WRITE (6,320) JJ,(B(J),J=1,25)
  320 FORMAT (/5X,'LABEL 320. ARRAY B IS FILLED; LOOK FOR MODE CHARACTER
     1. THE NUMBER OF ARRAY ELEMENTS PROCESSED INCLUDING STARS AND '/
     25X,'DOLLARS, JJ= ',I5,/5X,'FIRST 25 CHARACTERS ARE: ',
     3 10(1X,Z8)/5X,10(1X,Z8)/5X,5(1X,Z8)/)
C       TEST TO SEE IF THIS IS A KEYBOARD ENTRY OR A STAR (TRACER)
```

```
C        AND PERMIT THE POSSIBILITY THAT EITHER 'KEYBOARD' OR 'TRACER'
C        BUTTONS HAVE BEEN PUSHED TWICE.
C
C        IN USING THE CALMA DIGITIZER, SPURIOUS BLANK RECORDS WOULD
C        APPEAR AT RANDOM THROUGHOUT THE TAPE. WHEN THESE BLANK RECORDS
C        OCCUR DURING A HEADER RECORD NOTHING IS LOST SINCE HEADER
C        INFO IS EASILY INSERTED VIA DATA CARDS BY SETTING IHDR=1.
C        HOWEVER, IF A BLANK RECORD OCCURS DURING A TRACE RECORD THE
C        COMPLETE STATION IS LOST.  FROM EXPERIENCE A BLANK RECORD
C        NORMALLY WILL HAVE TWO CHARACTERS (IE. JJ=2). AFTER THE FIRST
C        RUN THE BLANK RECORDS CAN BE LOCATED AND CAN THEN BE SKIPPED
C        INDIVIDUALLY OR THE ENTIRE STATION CAN BE SKIPPED DEPENDING
C        ON WHETHER THE BLANK RECORD IS IN THE HEADER OR TRACE.
C        THIS PROBLEM IS SUSPECTED TO BE THE RESULT OF MECHANICAL
C        PROBLEMS WITH THE DIGITIZER ITSELF AND SHOULD NOT BE A
C        RECURRING PROBLEM.
      JJ = 1
      GO TO 360
C
C        THE FOLLOWING ROUTINE READS ANOTHER SET OF CARDS.  THIS IS THE
C        ENTRY FOR THE SITUATIONS IN WHICH THE IRG IS MISSED.
  330 READ (5,140) LABEL,JSKIP,ISTOP,AMONC
      IF (ISTOP.GT.0) GO TO 1370
      IF (JSKIP.EQ.0) GO TO 340
      READ (5,DAT)
      WRITE (6,150) LABEL
      WRITE (6,DAT)
      READ (5,CONTRL)
      WRITE (6,CONTRL)
C        DIAGNOSTIC WRITE STATEMENTS FOLLOW:
  340 IPLACE = 185
      WRITE (6,180) (D(J),J=1,1801,20),IPLACE
      WRITE (6,180) (T(J),J=1,1801,20),IPLACE
      WRITE (6,190) JJJ,NE,KDTH1,KDTH2,JJJJ
C
      WRITE (6,350) NOIRG,JJJJ
  350 FORMAT (/5X,'LABEL 185.  PROCESSING SECOND HALF.  NOIRG=',I3,
     1 'JJJJ=',I5/)
      NOIRG = 0
      JJ = JJJJ
C
C        INITIALIZE ADDERS,ETC.
  360 SUMD = 0.
      SUMT = 0.
      N = 0
      KL = 0
C
C        ****************************************************************
```

```
C***(1) DECODE HEADER LABEL.*********************************************
C
C       DIAGNOSTIC WRITE STATEMENTS FOLLOW:
  370 FORMAT (/5X,'B(JJ)=',Z8/)
  380 FORMAT (5X,I5/)
      WRITE (6,380) JJ
      WRITE (6,370) B(JJ)
C       LOOK FOR KEYBOARD SYMBOL.
C       CHECK THE FIRST 11 VALUES OF THE B ARRAY FOR A KEYBOARD
C       SYMBOL SINCE IT IS POSSIBLE TO HAVE BAD OR INVALID SYMBOLS AHEAD
C     OF KEYBOARD SYMBOL OF HEADER. IF ALL ELEVEN VALUES ARE NOT KEYS,
C       RESET JJ TO 1 (IE.JJ=JJ-10) AND PROCESS AS A TRACE. HOWEVER
C       IF ONE OF THE VALUES 1 THRU 11 IS A KEY GO TO 264 AND
C       PROCESS AS A HEADER.
C       IF A TRACER SYMBOL IMMEDIATELY FOLLOWS A KEY SYMBOL, THE HEADER
C       IS PROBABLY MISSING AND THE SEGMENT IS PROSESSED AS A TRACE.
C       (NOTE 1: IN THE CASE OF A HEADER JJ IS NOT RESET TO 1.
  390 IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ+1
      IF (B(JJ).EQ.KEY) GO TO 850
      JJ = JJ-10
  400 FORMAT (5X,'LABEL 400.',I5)
      WRITE (6,400) JJ
      IF (KL.EQ.1) GO TO 430
      IF (KL.EQ.2) GO TO 430
C       NO KEYBOARD SYMBOL; MAY HAVE FORGOTTEN IT.  TEST THE 5TH AND
C       6TH SYMBOLS (IDEPTH).  IF BOTH ARE NINES CALL IT A KEYBOARD
C       ANYWAY.
      IF (B(5).EQ.NINE.AND.B(6).EQ.NINE) GO TO 410
      GO TO 590
```

```
  410 IJJ = JJ+12
      WRITE (6,420) (B(I),I=JJ,IJJ)
  420 FORMAT (/5X,'AT 410, MISSING KEY.  B(1) TO B(13)=',13A1/)
C
C      PROCESS KEYBOARD ENTRIES.  CHANGE THE WORDS TO
C      INTEGER FORM BY SUBTRACTING Z404040F0 AND CREATE MULTI-DIGIT
C      INTEGERS.
C      SKIP=T PERMITS NAMELIST DATA CARDS TO OVERRIDE TAPE HEADING
C      INFO. ALL HEADING DATA MUST THEN BE PUT ON THE CARDS.
  430 IF (SKIP) GO TO 540
      ISTAA = 0
      IDENT = 0
C      DEFINE INDICES FOR DECODING THE LABEL
      KY1 = JJ
      KY2 = KY1+2
      KY3 = KY1+3
      KY4 = KY1+4
      KY5 = KY1+5
      KY6 = KY1+6
      KY7 = KY1+7
      KY8 = KY1+8
      KY9 = KY1+9
      KY10 = KY1+10
      KY11 = KY1+11
C
C      IF THERE IS A DLTREC IN THE HEADER, IT IS FOUND HERE. READ IN A
C      NEW RECORD, AND USE THE SAME CARDS.
C
C
C
      DO 440 J=KY1,KY10
      IF (B(J).EQ.DLTREC) GO TO 450
  440 CONTINUE
C
C
C
      GO TO 480
  450 WRITE (6,460)
  460 FORMAT (/5X,'DLTREC IN HEADER. REPEAT,USING SAME CARDS.'/)
  470 IT = IT+1
      GO TO 170
C
C      DO THE CONVERSION, COMPARE WITH VALUES READ FROM THE CARDS,ACCEPT
C      THE CARDS.
C
  480 CONTINUE
C
C
```

```
C
      DO 490 J=KY1,KY2
      B(J) = B(J)-ZER
      IB = B(J)
  490 ISTAA = ISTAA+IB*10**(KY2-J)
C
C
C
      AMONT = B(KY3)
C
C
C
      DO 500 J=KY4,KY5
      B(J) = B(J)-ZER
      IB = B(J)
  500 IDENT = IDENT+IB*10**(J-KY4)
C
C
C
      IDSC = B(KY6)-ZER
      ICOD = B(KY7)-ZER
      ITSCL1 = B(KY8)-ZER
      ISCL1 = B(KY9)-ZER
      IPP = B(KY10)-ZER
C
C      IF THERE IS A DISAGREEMENT, WRITE A MESSAGE.
      IF (ISTAA.NE.ISTA) GO TO 520
      IF (IDENT.NE.IDEN) GO TO 520
      IF (IDSC.NE.IDSCL) GO TO 520
      IF (ICOD.NE.ICODE) GO TO 520
      IF (ITSCL1.NE.ITSCL) GO TO 520
      IF (ISCL1.NE.ISCL) GO TO 520
      IF (IPP.NE.IP) GO TO 520
  510 FORMAT (5X,'LABEL=510.   CARD INPUTS EQUALLED TAPE HEADER FOR
     1 STATION ',I3,A1/5X,'IDEPTH= ',I3/)
      WRITE (6,510) ISTA,AMONC,IDEN
      GO TO 540
  520 WRITE (6,530) ISTA,AMONC,IDEN,IDSCL,ICODE,ITSCL,ISCL,IP,ISTAA,AMON
     1T,IDENT,IDSC,ICOD,ITSCL1,ISCL1,IPP
  530 FORMAT (/3X'CARD AND TAPE DISAGREE, CARD ON TOP'/3X,'   ISTA  AMON
     1C IDENT   IDSCL  ICODE  ITSCL   ISCL    IP'/3X,I7,A7,6I7/3X,I7,
     2 A4,I10,5I7/)
C      WRITE THE RESULTS
  540 WRITE (6,550) ISTA,AMONC,IDEN
  550 FORMAT (5X,'LABEL 550.  HEADER PROCESSING COMPLETE EXCEPT SEARCH
     1  FOR ERRORS ON STATION ',I3,A1/5X,'IDEN= ',I3/)
C
C      CONSIDER IT POSSIBLE THAT NO IRG EXISTS AFTER THE HEADER.
```

```
C        THE PROGRAM HAS FILLED THE B ARRAY WITH BOTH THE HEADER AND
C        TEMPERATURE TRACE. ASSUME THERE IS A TRACER SYMBOL IN POS-
C        ITION 12. IF THIS IS SO, CONTINUE TO PROCESS THE B ARRAY.
      IF (B(KY11).NE.STAR) GO TO 570
      JJJJ = KY11
      WRITE (6,560)
  560 FORMAT (/5X,'NO IRG AFTER HEADER; CONTINUE TO PROCESS B ARRAY.'/)
      GO TO 330
  570 IF (IHDR.EQ.0) GO TO 1360
C
C        THIS BRANCH RETURNS TO 120 IF THE HEADER IS MISSING. SET IHDR=1
C        ON THE CARD.
      WRITE (6,580)
  580 FORMAT (/5X,'HEADER MISSING; INFO INSERTED WITH CARDS.'/)
      IHDR = 0
      GO TO 120
C
C        *********************************************************************
C***(2) PROCESS TRACE BY SUMMING X AND Y.************************************
C
C        THE FOLLOWING PROCEDURE PERMITS THE PRESENCE OF ANY REASONABLE
C        NUMBER OF TRACER SYMBOLS (STAR) INCLUDING NONE.
  590 NE = 0
      NF = 0
      NSTAR = 0
  600 IF (B(JJ).EQ.STAR) GO TO 620
C
C        COUNT STARS AND WRITE MESSAGE
      WRITE (6,610) NSTAR
  610 FORMAT (/5X,'START TRACER MODE; NO. OF TRACER SYMBOLS =',I2/)
C        WHEN THERE ARE NO MORE STARS, START TESTING FOR COUNT SYMBOLS ETC
      GO TO 630
  620 JJ = JJ+1
      NSTAR = NSTAR+1
C        CONTINUE TO TEST FOR STARS UNTIL NO MORE APPEAR.
      GO TO 600
C
C        THE NEXT BLOCK OF OPERATIONS TO JUST BEYOND 820 LOOPS BACK TO
C        630 CONTINUALLY, TESTING EACH CHARACTER FOR IDENTITY AND
C        CONTINUING TO ADD OR SUBTRACT FROM THE CUMULATIVE Y AND X COUNTS
C        UNTIL A DELETE-RECORD SYMBOL OR A STAR OR A DOLLAR INDICATES
C        THE END OF DATA. THE FLAG IS PLACED AT THE POINT WHERE THE TRACE
C        ACTUALLY BEGINS TO RECORD T VS D. PREVIOUS COUNTS RESULT
C        FROM THE TRACER TRAVELING FROM THE COORDINATE ORIGIN TO THIS
C        POINT.
  630 IF (B(JJ).EQ.ONE) GO TO 650
      IF (B(JJ).EQ.BLANK) GO TO 660
      IF (B(JJ).EQ.MINUS) GO TO 670
```

```
      IF (B(JJ).EQ.FLAG) GO TO 820
      IF (B(JJ).EQ.KEY) GO TO 390
C      THE NEXT GROUP OF STATEMENTS ALLCW FOR OCCASIONAL COUNTS GREATER
C      THAN + OR - 1.
      IF (B(JJ).EQ.TWO) GO TO 680
      IF (B(JJ).EQ.THREE) GO TO 690
      IF (B(JJ).EQ.FOUR) GO TO 700
      IF (B(JJ).EQ.FIVE) GO TO 710
      IF (B(JJ).EQ.SIX) GO TO 720
      IF (B(JJ).EQ.SEVEN) GO TO 730
      IF (B(JJ).EQ.EIGHT) GO TO 740
      IF (B(JJ).EQ.NINE) GO TO 750
      IF (B(JJ).EQ.TEN) GO TO 760
      IF (B(JJ).EQ.ELEVEN) GO TO 770
      IF (B(JJ).EQ.MTWO) GO TO 780
      IF (B(JJ).EQ.MTHREE) GO TO 790
      IF (B(JJ).EQ.MFOUR) GO TO 800
      IF (B(JJ).EQ.MFIVE) GO TO 810
      IF (B(JJ).EQ.DLTREC) GO TO 920
      WRITE (6,640) B(JJ)
  640 FORMAT (//5X,'SYMBOL NOT RECOGNIZED = ',Z8//)
C      WE ELIMINATE PRINTING OF THIS STATION AND INITIALIZE VARIABLES
C      IF IP ALSO IS EQUAL TO 1.
      IF (IP.EQ.1) GO TO 1330
      GO TO 1360
  650 RX = 1.
      GO TO 860
  660 RX = 0.
      GO TO 860
  670 RX = -1.
      GO TO 860
  680 RX = 2.
      GO TO 860
  690 RX = 3.
      GO TO 860
  700 RX = 4.
      GO TO 860
  710 RX = 5.
      GO TO 860
  720 RX = 6.
      GO TO 860
  730 RX = 7.
      GO TO 860
  740 RX = 8.
      GO TO 860
  750 RX = 9.
      GO TO 860
  760 RX = 10.
```

```
      GO TO 860
  770 RX = 11.
      GO TO 860
  780 RX = -2.
      GO TO 860
  790 RX = -3.
      GO TO 860
  800 RX = -4.
      GO TO 860
  810 RX = -5.
      GO TO 860
  820 JJJ = NE
      JJ = JJ+1
      FG = 1
      GO TO 630
C      CHECK HERE FOR MULTIPLE KEYBOARD SYMBOLS. IF NUMBER EXCEEDS
C      EIGHT TERMINATE THE PROGRAM. THE NUMBER EIGHT IS ARBITRARY.
C      SELDOM DOES ONE GET MORE THAN THREE KEYBOARD SYMBOLS ON THE TAPE
C      ACCIDENTALLY.
  830 WRITE (6,840)
  840 FORMAT (5X,'FOUND EIGHT KEYBOARD SYMBOLS IN SEQUENCE.  STOP.')
      GO TO 1360
  850 KL = KL+1
      JJ = JJ+1
      IF (KL.EQ.8) GO TO 830
      IF (B(JJ).EQ.STAR) GO TO 590
C      TRY AGAIN
      GO TO 390
C
C      THE ADDING IS DONE HERE AND THE CUMULATIVE SUM STORED, ONE
C      UNIT PER .01 INCH.
  860 N = N+1
      NE = N/2
      NF = NE*2
      IF (NF.EQ.N) GO TO 870
C      THIS FIDDLING AROUND DETERMINES IF  THE COUNT IS EVEN OR ODD.
C      START COUNTING IN THE ORDER YXYX (BECAUSE THE CHART IS READ
C      SIDEWAYS.  X AND Y IN THIS PROGRAM HAVE THE NORMAL ORIENTATIONS
C      ON THE STRIP CHART.  THEY ARE INVERTED WITH RESPECT TO THE
C      CALMA DIGITIZER. SPECIFICALLY DEPTH DECREASES ALONG THE
C      POSITIVE X AXIS AND TEMP INCREASES ALONG THE POSITIVE Y AXIS
C      ON THE CALMA DIGITIZER.
C
C      IF ODD
      SUMD = SUMD+RX
C      INCREASE THE ODD INDEX TO KEEP IT THE SAME AS THE EVEN.
      NE = NE+1
      Y(NE) = SUMD
```

```
      JJ = JJ+1
      GO TO 880
C
C       IF EVEN
  870 SUMT = SUMT+RX
      X(NE) = SUMT
      JJ = JJ+1
C       IF A STAR OR DOLLAR IS FOUND, THIS IS THE END OF THE DATA.
  880 IF (B(JJ).EQ.DLR) GO TO 940
C       END NORMAL TRACE PROCESSING
C
C       BEGIN TROUBLE SHOOTING
C       IF THERE IS NO IRG BETWEEN TRACES BUT THERE IS A TRACER SYMBOL,
C       THE TWO CAN BE SEPARATED BY FIRST SETTING
C       NOIRG=1, DOING NORMAL PROCESSING ON THE FIRST PART OF THE
C       B ARRAY, READING A NEW SET OF CARDS, AND THEN PROCESSING THE
C       SECOND PART OF B.
      IF (B(JJ).NE.STAR) GO TO 900
      NOIRG = 1
C       SAVE THE INDEX OF THE START OF THE SECOND HALF, JJJJ.
      JJJJ = JJ
      WRITE (6,890)
  890 FORMAT (/5X,'FOUND A STAR AT END CF TRACER ASSUME THERE IS NO IRG.
     1'/5X,'PROCESS RECORD IN TWO PARTS, READING CARDS FOR BOTH PARTS.'/
     2)
      GO TO 940
  900 IF (B(JJ).NE.KEY) GO TO 630
      JJJJ = JJ
      WRITE (6,910)
  910 FORMAT (/5X,'FOUND A KEYBOARD SYMBOL.  PROCESS NEXT PORTION OF B A
     1RRAY AFTER READING NEW CARDS.'/)
      NOIRG = 1
      GO TO 940
C
  920 WRITE (6,930) JJ
  930 FORMAT (5X,'FOUND DELETE RECORD SYMBOL AT JJ= ',I5)
C       IF DELETE RECORD IS FOUND, GO TO 470  AND INCREMENT THE
C       VARIABLE, IT, BUT RETURN TO STATEMENT 170. A NEW SET OF CARDS
C       IS NOT READ BUT THE RECORD COUNT, IT, IS INCREMENTED.
      GO TO 470
  940 JJ = JJ-1
C
C       END TRACER AND ASSOCIATED TROUBLE SHOOTING
C
C       ***************************************************************
C***(J) CONVERT X AND Y ARRAYS TO DEPTH AND TEMPERATURE.****************
C
      WRITE (6,950) JJJ,NE,Y(NE),X(NE)
```

```
950 FORMAT (/5X,'LABEL 950.  START CONDENSING UNCONVERTED ARRAY AND CO
   1NVERTING TO SCIENTIFIC UNITS.'/5X,'THE TRACER ENTERED THE FRAME (F
   2LAG) AT JJJ= ',I5/5X,'THE END OF THE TRACE HAS INDEX NE= ',I5/
   3 5X,'LAST (UNCONVERTED) DEPTH AND TEMP ARE: ',F7.1,2X,F7.1/)
C
C
C      CHECK TO SEE IF FLAG WAS FOUND.
      IF (FG.EQ.1) GO TO 970
      WRITE (6,960)
960   FORMAT (/5X,'NO FLAG FOUND; PROCESS ANYWAY.'/)
970   WRITE (6,980)
980   FORMAT (' ')
      FG = 0
C
C      THE X AND Y ARRAYS ARE FILLED AND THE START AND END OF THIS BATCH
C      OF DATA ARE LABELED WITH JJJ AND NE. THE ARRAYS ARE INDEXED
C      ON  0.01 INCH DEPTH SPACING. SUBROUTINE CONDNS INTERPOLATES TO
C      FILL ANY BLANK ARRAY POSITIONS.
      CALL CONDNS (X,Y,T,JJJ,NE,KDTH1,KDTH2)
C
C
C
      DO 1060 J=KDTH1,KDTH2
      D(J) = (J-1)/DCON(IDSCL)+DCOR
C      SUBROUTINE WLQP2, LOCATED IN THE SUBROUTINE LIBRARY OF THE W. R.
C      CHURCH COMPUTER CENTER WAS USED TO DETERMINE THE COEFFICIENTS
C      FOR A BEST FIT SECOND DEGREE POLYNOMIAL THAT DESCRIBED THE
C      RELATIONSHIP BETWEEN THE TEMP AND THE MOVEMENT OF THE STYLUS
C      AS MEASURED IN HUNDREDS OF INCHES.
C      A SINGLE POLYNOMIAL DID NOT ACCURATELY DESCRIBE
C      THIS RELATIONSHIP. IT WAS NECESSARY TO BREAK THE TRACE INTO
C      FIVE SEGMENTS. THE FIRST EQUATION WAS DETERMINED FOR TEMPS FROM
C      1 TO 5 DEG., THE NEXT EQUATION FROM 5 TO 10 DEG., ETC, UP TO A
C      MAXIMUM OF 25 DEG. BY USING SEGMENTS THE EQUATIONS ARE ACCURATE
C      TO WITHIN AT LEAST 0.01 DEG.
C
C      TCOR IS A TEMP CORRECTION WHICH MAY BE APPLIED TO A SINGLE
C      STATION IF NECESSARY. A SINGLE STATION MAY BE IN ERROR DUE
C      TO IMPROPER DIGITIZING TECHNIC. IF THE OPERATOR STARTS TO
C      TRACE AT A POINT WHICH IS NOT THE ORIGIN A CONSTANT CORR. CAN
C      SHIFT THE TRACE BACK TO THE ORIGIN.
C      XBTCOR IS A CORRECTION DESIGNED TO MAKE THE XBT READING
C      AGREE WITH A STANDARD, EITHER WITH A NANSEN CAST OR A
C      STANDARDIZED STD TRACE WHICH WAS MADE AT THE SAME TIME.
C      GENERALLY THE XBT TEMP WAS NOTICABLY HIGHER THAN THE TEMPS
C      RECORDED BY THE OTHER TWO METHODS. THIS CORRECTION ENABLES ONE TO
C      COMPARE TEMPS TAKEN BY DIFFERENT METHODS.
C
```

```
      IF (T(J).LT.16.6) WRITE (6,990)
  990 FORMAT (/5X,'T(J) LESS THEN 1.0 DEG')
      IF (T(J).LT.16.6) GO TO 1060
      IF (T(J).GT.88.2) GO TO 1000
      T(J) = .0509421+.057236*T(J)-.0000125*T(J)*T(J)+TCOR+XBTCOR
      GO TO 1060
 1000 IF (T(J).GT.182.8) GO TO 1010
      T(J) = .179875+.0556283*T(J)-.0000104*T(J)*T(J)+TCOR+XBTCOR
      GO TO 1060
 1010 IF (T(J).GT.280.2) GO TO 1020
      T(J) = .520519+.0522706*T(J)-.0000021*T(J)*T(J)+TCOR+XBTCOR
      GO TO 1060
 1020 IF (T(J).GT.378.8) GO TO 1030
      T(J) = 2.18667+.042103*T(J)+.0000129*T(J)*T(J)+TCOR+XBTCOR
      GO TO 1060
 1030 IF (T(J).GT.475.6) GO TO 1040
      T(J) = 2.55982+.0415735*T(J)+.0000118*T(J)*T(J)+TCOR+XBTCOR
      GO TO 1060
 1040 IF (T(J).GT.475.6) WRITE (6,1050)
 1050 FORMAT (/5X,' T(J) EXCEEDS 25 DEG.')
 1060 CCNTINUE
C
C
C
C       ****************************************************************
C***(K) MANUALLY INSERT SURFACE AND NEAR SURFACE VALUES.****************
C
C       THE T ARRAY IS NOW CONVERTED, AND IT IS NOW NECESSARY
C       TO REINSERT SURFACE AND NEAR SURFACE DATA.  NORMALLY, ONLY
C       SURFACE VALUES  NEED TO BE INSERTED DUE TO THE DIGITIZER OPERATOR
C       BEGINNING HIS TRACING SLIGHTLY BELOW HIS ZERO DEPTH REFERENCE.
C       SURFACE VALUES ARE INSERTED BY CHECKING THE VALUE OF IH.
C       IF IH EQUALS ZERO, NO DATA IS INSERTED MANUALLY. IF IH=1,SURFACE
C       DEPTH AND TEMPERATURE ARE INSERTED VIA &DAT DATA CARD FOR THE
C       PARTICULAR STATION. THIS HAND ENTERED DATA IS STORED IN THE
C       DH AND TH ARRAYS. INFREQUENTLY IT MAY BE NECESSARY TO MANUALLY
C       INSERT DATA VALUES FOR DEPTHS AT NEAR SURFACE.
C       THIS IS AGAIN NECESSARY ONLY IF THE
C       DIGITIZER OPERATOR BEGAN DIGITIZING WELL BELOW THE ZERO DEPTH
C       REFERENCE. SINCE THIS OCCURS INFREQUENTLY AND INVOLVES A SIGNIF-
C       ICANT AMOUNT OF WORK TO MANUALLY INSERT THE DATA VIA CARDS, THIS
C       OPERATION IS PERFORMED CNLY WHEN WRITING THE COMPOSITE TAPE AND
C       CONSEQUENTLY ONLY WHEN ISQZ=1.THUS TO INSERT NEAR SURFACE DATA
C       IHMUSTBEGREATERTHANOREQUALTO2ANDISQZ=1.DHANDTHARE
C       DIMENSIONED AT 12 , WHICH EQUATES TO APPROXIMATELY 10.5 METERS AT
C       ISQZ=1.  ISQZ=1 WAS CHOSEN BECAUSE ALL OF THE ELEMENTS OF THE D,T
C       ARRAYS ARE PRINTED AS OUTPUT VIA OUT2. THIS ELIMINATES "GUESSWORK
C       WITH RESPECT TO WHICH VALUES NEED TO BE INSERTED, SINCE ALL
```

```
C       VALUES ARE INSERTED.  IF THERE IS A GAP BETWEEN HAND ENTERED
C       DATA AND XBT DATA , IT IS NOT FILLED.
C
      IF (IH.EQ.0) GO TO 1080
      T(1) = TH(1)
      IF (IH.LT.2) GO TO 1080
      IF (ISQZ.GT.1) GO TO 1080
C
C
C
      DO 1070 J=2,IH
      D(J) = DH(J)
      T(J) = TH(J)
 1070 CONTINUE
C
C
C
 1080 CONTINUE
C
C      DIAGNOSTIC WRITE STATEMENTS FOLLOW:
C-------------------
      IPLACE = 1080
      WRITE (6,180) (D(J),J=1,1801,20),IPLACE
      WRITE (6,180) (T(J),J=1,1801,20),IPLACE
      WRITE (6,190) JJJ,NE,KDTH1,KDTH2,JJJJ
C-------------------
C
C       *************************************************************
C***(L) ELIMINATE UNWANTED DATA.*************************************
C
C       IN DIGITIZING TEMP SEGMENTS ONE FREQUENTLY GETS UNUSUAL VALUES
C       AT THE TOP OR BOTTOM OF THE TRACE SEGMENT (ZERO OR VERY HIGH). IT
C       IS DESIRABLE THAT THESE UNWANTED VALUES BE ELIMINATED PRIOR TO
C       WRITING A TAPE OR PUNCHING CARDS. THUS A CHECK IS MADE TO SEE
C       IF T(J) IS ZERO OR GREATER THAN 25.
C
C       THESE VALUES ARE WRITTEN OUT
C       AND COUNTED FOR RECORD PURPOSES BUT ARE DISCARDED FROM THE
C       D AND T ARRAYS. NOTE THE VALUE OF KDTH2, WHICH IS EQUAL TO THE
C       TOTAL NUMBER OF RECORDS, IS REDUCED BY THE NUMBER OF UNWANTED
C       RECORDS.
      K = 0
      L = 1
C
C
C
      DO 1110 J=1,KDTH2
      IF ((T(J).EQ.0.0).OR.(T(J).GT.25.0)) GO TO 1090
```

```
      D(L) = D(J)
      T(L) = T(J)
      L = L+1
      GO TO 1110
 1090 WRITE (6,1100) D(J),T(J),J
      K = K+1
      JSAV = K
 1100 FORMAT (//5X,2F7.2,I6,//)
 1110 CONTINUE
C
C
C
 1120 FORMAT (//5X,' JSAV=',I6,//)
      WRITE (6,1120) JSAV
      KDTH2 = KDTH2-JSAV
C
C      ******************************************************************
C***(M) GENERATE SERIAL NUMBERS FOR TAPE OUTPUT.*************************
C
C      GENERATE SERIAL NUMBERS FOR THE RECORDS. A RECORD IS
C      EITHER A HEADER FOR A STATION OR THE VALUES  (D AND T) FOR
C      A SINGLE DEPTH.
C
C
C
      DO 1130 J=1,KDTH2
      JREC = JREC+1
      IREC(J) = JREC
 1130 CONTINUE
C
C
C
C      ******************************************************************
C***(N) CONVERT LETTER CODE TO MONTH/YEAR.*******************************
C
C      THIS SECTION CONVERTS THE LETTER DESIGNATOR FOR MONTH (AMONC)
C      FROM THE SINGLE LETTER CODE ON THE DIGITIZED TAPE TO THE
C      APPROPRIATE MONTH AND YEAR IN PREPARATION FOR WRITING THE OUTPUT.
C
C
C
      DO 1140 J=1,13
      IF (AMONC.EQ.AMONCA(J)) GO TO 1160
 1140 CONTINUE
C
C
C
 1150 FORMAT (15X,'AMONC NEVER DID EQUAL AMONC(J) CONSEQUENTLY,
```

```
    1 WMONTH WILL NOT BE DEFINED'/)
      WRITE (6,1150)
      GO TO 1170
 1160 WMONTH = EVENT(J)
 1170 CONTINUE
C
C      ****************************************************************
C***(0) OUTPUT.*********************************************************
C
C       PRINT DATA
C
C       THE PARAMETER ISQZ PERMITS CONDENSING THE PRINTED DATA BY THE
C       FACTOR ISQZ
C
      IF (.NOT.PRT1) GO TO 1190
C
      WRITE (6,1180)
 1180 FORMAT ('1')
      CALL OUT2 (D,T,KDTH2,ISTA,WMONTH,IREC,JREC,ISQZ)
C
C       WRITE TAPE
C
C       TAPE MUST BE TRUE ONLY ONCE, AT THE BEGINNING OF TAPE  WRITING.
C       THE PROGRAM EXPECTS JCL TO WRITE CARD IMAGES ON THE TAPE
C       IN RECORDS 20 DIGITS LONG.
 1190 IF (.NOT.TAPE) GO TO 1230
C       WRITE THE HEADER INFO HERE.
      WRITE (8,1200) ISTA,WMONTH,KDTH2
 1200 FORMAT (I4,A9,I6)
      WRITE (8,1210) (D(J),T(J),J=1,KDTH2)
 1210 FORMAT (F8.2,F6.2)
      WRITE (6,1220) ISTA,WMONTH,JREC
 1220 FORMAT (5X,'DATA FOR STATION ',I5,A12,' WRITTEN ON TAPE UP TO
    1  RECORD ',I6)
C
C       PUNCH CARDS
C
C       COMPRESS THE PUNCHED DATA BY A FACTOR ICSQZ. FORMAT FOR FOUR
C       DATA SETS ON A CARD. NPTS  BECOMES THE NUMBER OF DATA PRINTED
C       IF IT IS EVENLY DIVISIBLE. OTHERWISE THE LAST DATUM IS ALSO
C       PUNCHED. SUPPLY JCL FOR CARD PUNCHING.
C
 1230 IF (.NOT.CARDS) GO TO 1330
C
C       THE NUMBER OF POINTS TO BE RETAINED AFTER CONDENSATION IS
C       1+(N-1)/ISQZ. IF THIS DOES NOT COME OUT INTEGRAL ADD THE LAST
C       POINTS.
      NPTS = (KDTH2-1)/ICSQZ
```

```
      NPT1 = KDTH2-1-ICSQZ*NPTS
      NPTS = NPTS+1
C      WRITE A HEADER CARD
 1240 FORMAT (14X,'OCEANOGRAPHIC DATA FROM U C M II',//)
 1250 FORMAT (1X,I4,' VALUES OF D,T FOR XBT STA.',I3,A8,'COMPRESSED BY',
     1 I3,/)
 1260 FORMAT (4X,'DEPTH',2X,'TEMP.',2X,'DEPTH',2X,'TEMP.',2X,'DEPTH',
     1 2X,'TEMP.',2X,'DEPTH',2X,'TEMP.')
 1270 FORMAT (4X,'METERS',1X,'DEG.C.',1X,'METERS',1X,'DEG.C.',1X,'METERS
     1',1X,'DEG.C.',1X,'METERS',1X,'DEG.C.',/)
      WRITE (7,1240)
      WRITE (7,1250) NPTS,ISTA,WMONTH,ICSQZ
      WRITE (7,1260)
      WRITE (7,1270)
C      NOW FIND THE NUMBER OF CARDS
      NCARDS = NPTS/4
      NCRD1 = NPTS-4*NCARDS
C      THERE WILL BE ONE MORE CARD IF NCRD1.NE.0.
      INCR = 4*ICSQZ
      J = 1-INCR
      K = 0
 1280 J = J+INCR
      K = K+1
      J1 = J+ICSQZ
      J2 = J1+ICSQZ
      J3 = J2+ICSQZ
 1290 FORMAT (2X,4(F8.2,F6.2),3X,I3,A10,I6)
      WRITE (7,1290) D(J),T(J),D(J1),T(J1),D(J2),T(J2),D(J3),T(J3),ISTA,
     1WMONTH,JREC
      IF (K.LT.NCARDS) GO TO 1280
      IF (NCRD1.EQ.0) GO TO 1320
C      WRITE THE LAST CARD
      J = J3+ICSQZ
      WRITE (7,1290) D(J),T(J)
      IF (J.EQ.KDTH2) GO TO 1320
      J = J+ICSQZ
 1300 FORMAT (1H+,16X,F8.2,F6.2)
      WRITE (7,1300) D(J),T(J)
      IF (J.EQ.KDTH2) GO TO 1320
      J = J+ICSQZ
 1310 FORMAT (1H+,30X,F8.2,F6.2)
      WRITE (7,1310) D(J),T(J)
 1320 CONTINUE
C
 1330 IF (ENDFL) END FILE 8
C      ENDFL MUST BE TRUE ONCE ON THE LAST TAPE WRITING OPERATION.
C
C      ****************************************************************
```

```
C***(P) INITIALIZE VARIABLES FOR NEXT STATION.***************************
C
      JREC = JREC+1
C
C
C
      DO 1340 J=1,1801
      D(J) = 0.
      T(J) = 0.
 1340 CONTINUE
C
C
C
C
      DO 1350 J=1,12
      TH(J) = 0.
      DH(J) = 0.
 1350 CONTINUE
C
C
C
      SKIP = .FALSE.
      IDEN = 0
      IH = 0
      IP = 0
      JSAV = 0
      IF (NOIRG.EQ.1) GO TO 330
C
 1360 IT = IT+1
      GO TO 120
 1370 STOP
      END


C      ---------------SUBROUTINE OUT2 -------------------
C      THIS OUTPUT SUBROUTINE FOR DIGIXBT PRINTS DEPTHS AND TEMPS
C      FOUR COLUMNS TO A PAGE.
C
      SUBROUTINE OUT2 (D,T,KDTH2,ISTA,WMONTH,IREC,JREC,ISQZ)
      REAL *8WMONTH
      DIMENSION D(1801), T(1801), IREC(1801)
C      PRODUCE HEADING
   20 FORMAT (14X,'OCEANOGRAPHIC DATA FROM U C M II',//)
   30 FORMAT (1X,I4,' VALUES OF D,T FOR XBT STA.',I3,A8,'COMPRESSED BY',
     1 I3,/)
```

```
   40 FORMAT (4X,'DEPTH',2X,'TEMP.',2X,'DEPTH',2X,'TEMP.',2X,'DEPTH',
     1 2X,'TEMP.',2X,'DEPTH',2X,'TEMP.')
   50 FORMAT (4X,'METERS',1X,'DEG.C.',1X,'METERS',1X,'DEG.C.',1X,'METERS
     1',1X,'DEG.C.',1X,'METERS',1X,'DEG.C.',/)
      NPTS = NPTS+1
      INCR = 4*ISQZ
      NPTS = (KDTH2-1)/ISQZ
      WRITE (6,20)
      WRITE (6,30) NPTS,ISTA,WMONTH,ISQZ
      WRITE (6,40)
      WRITE (6,50)
C       COMPUTE NUMBER OF FULL LINES
      NLNS = (KDTH2-1+ISQZ)/INCR
      NLN1 = KDTH2-1-(4*NLNS-1)*ISQZ
      J = 1-INCR
      K = 0
   60 J = J+INCR
      K = K+1
      J1 = J+ISQZ
      J2 = J1+ISQZ
      J3 = J2+ISQZ
   70 FORMAT (2X,4(F8.2,F6.2),10X,2I6)
      WRITE (6,70) D(J),T(J),D(J1),T(J1),D(J2),T(J2),D(J3),T(J3),IREC(J)
     1,IREC(J3)
      IF (K.LT.NLNS) GO TO 60
C
      IF (NLN1.EQ.0) GO TO 120
C       WRITE THE LAST LINE
      J = J3+ISQZ
      WRITE (6,70) D(J),T(J)
      IF (J.EQ.KDTH2) GO TO 110
      J = J+ISQZ
   80 FORMAT (1H+,15X,F8.2,F6.2)
      WRITE (6,80) D(J),T(J)
      IF (J.EQ.KDTH2) GO TO 110
      J = J+ISQZ
   90 FORMAT (1H+,29X,F8.2,F6.2)
      WRITE (6,90) D(J),T(J)
  100 FORMAT (1H+,73X,I6)
  110 WRITE (6,100) IREC(J)
  120 CONTINUE
C
C       COUNT RECORDS
  130 FORMAT (//5X,'THIS STATION CONTAINS RECORDS ',I5,' TO ',I5,' INCLU
     1SIVE. '/)
      WRITE (6,130) IREC(1),JREC
  140 FORMAT (1H1)
      WRITE (6,140)
```

```
      RETURN
      END

C     ------------------------------SUBROUTINE CONDNS-------------------------
C      THIS SUBROUTINE FINDS THE ARRAY LOCATIONS FOR X, INDEXED
C      SEQUENTIALLY FOR EACH UNIT OF Y.  EACH UNIT OF Y IS 1.0 AND
C      CORRESPONDS TO .01 INCHES OF TRAVEL IN THE DEPTH DIRECTION.
C
      SUBROUTINE CONDNS (X,Y,T,JJJ,NE,KDTH1,KDTH2)
      DIMENSION X(1), Y(1), T(1), KINS(10), KNO(10)
C      IF FIRST INDEX IS ZERO OR NEGATIVE THERE IS A MISBEHAVIOR ELSE-
C      WHERE IN THE PROGRAM.  RESET JJJ TO 1.
      IF (JJJ.GE.1) GO TO 30
      JJJ = 1
      WRITE (6,20)
   20 FORMAT (/5X,'****** JJJ RESET TO ONE - SOMETHING WRONG ******'/)
C      KDTH1 BECOMES THE INDEX OF THE START OF THIS ARRAY SEGMENT.
   30 KDTH1 = Y(JJJ)+1.50
C      BUT IN CASE KDTH1 BECOMES ZERO OR LESS, USE THE START OF THE
C      CURVE AS THE ORIGIN OF INDEXING.
C      THIS CAUSES AN OVERLAP BETWEEN ARRAYS, BUT IT SHOULD BE SMALL.
      XINC = 0.
      IF (KDTH1.GT.0) GO TO 40
      XINC = FLOAT(1-KDTH1)
      KDTH1 = 1
C
   40 JJ1 = JJJ+1
      NE1 = NE-1
C      FORM SUBSCRIPTS FROM THE DEPTH INCREMENTS AND STORE X'S AT THOSE
C      ARRAY LOCATIONS.
C      SEARCH FOR BLANKS IN ARRAY BETWEEN INDEXES KDTH1 AND KDTH2.
C      KCT COUNTS THE NUMBER OF BLANKS
      KCT = 0
      KSAV = KDTH1
C      KINS(J) IS THE NUMBER OF THE ARRAY POSITION FILLED.
C
C
C
      DO 50 J=1,10
      KNO(J) = 0
   50 KINS(J) = 0
C
C
C
```

```
C
      DO 80 J=JJ1,NE1
      KDTH = Y(J)+1.50+XINC
      T(KDTH) = X(J)
C      TEST TO SEE IF INDEX IS THE SAME OR ONE GREATER THAN THE LAST
C      ONE.  IF NOT, INTERPOLATE VALUES.
      NREP = KDTH-KSAV
      IF (NREP.LE.1) GO TO 70
      KCT = KCT+1
      IF (KCT.GT.10) KCT = 10
      KNO(KCT) = NREP
      KINS(KCT) = KDTH
      II = KSAV+1
      III = KDTH-1
      E = FLOAT(NREP)
      G = T(KDTH)
      F = G-T(KSAV)
C
C
C
      DO 60 I=II,III
   60 T(I) = (FLOAT(I-KSAV)/E)*F+G
C
C
C
   70 KSAV = KDTH
   80 CONTINUE
C
C
C
      KDTH2 = Y(NE)+1.50+XINC
C      PUT IN THE FIRST POINT, WHICH OTHERWISE WOULD BE THE LAST
C      ONE FOR WHICH Y(J).LT.1.
      T(KDTH1) = X(JJJ)
      T(KDTH2) = X(NE)
C      SAVE INDEX OF END OF ARRAY.
C
C      WRITE DOWN NUMBER AND LOCATIONS OF INTERPOLATED VALUES.
      WRITE (6,90) KCT,(KINS(I),I=1,KCT),(KNO(I),I=1,KCT)
   90 FORMAT (/5X,'BLANK ARRAY POSITIONS FILLED IN ',I3,' PLACES.  BEGIN
     1NING INDEXES AND NO. OF STEPS'/5X,'(10 EACH) ARE: ',5X,10I6/
     2 5X,10I6/)
      RETURN
      END
```

```
C        ---------------SUBROUTINE CHMOVE -----------------------------------
         SUBROUTINE CHMOVE (A,I,B,J)
C         THIS SUBROUTINE RETURNS A LOGICAL*1 VARIABLE TO A 4-BYTE ADDRESS
C         IN THE MAIN PROGRAM, UNPACKING THE ORIGINAL 4-BYTE WORDS A
C         BYTE AT A TIME.
         LOGICAL *1A(1),B(1)
         B(J) = A(I)
         RETURN
         END
```

```
*        ................................................................
*
          MACRO
          REGS
          LCLA   &N
          LCLC   &SYM
.LOOP     ANOP
&SYM      SETC   '&N'
R&SYM     EQU    &SYM
&N        SETA   &N+1
          AIF    (&N LT 16).LOOP
          MEND
          SPACE 2
TPRD     CSECT
          SPACE 2
          REGS
          SPACE 2
          STM    R14,R12,12(R13)
          LR    R12,R15
          USING TPRD,R12
          LA     R11,SAV1       LINK  SAVE REGISTERS
          ST     R13,4(R11)
          ST     R11,8(R13)
          LR     R13,R11
          LR     R11,R1          GET ADDRESS OF ARGUMENT LIST
          USING ARGS,R11
          L      R10,AADD
          ST     R10,SHOVAAD     PUT IN LIST FOR SHOVE CALL
          L      R10,ALADD
          L      R10,0(R10)      PUT LENGTH IN SAME LIST
          ST     R10,SHOVALN
          LA     R10,TPDCB
          USING IHADCB,R10
          TM     DCBOFLGS,X'10' HAS DCB BEEN OPENED?
```

```
         BO     OOKK          YES                                                    TPR01640
         TM     BADBOMB,X'AA'  HAS THERE BEEN PREVIOUS CATASTROPHE?                  TPR01650
         BNO    ONWITHIT       NOPE, GO AND OPEN IT                                  TPR01660
         SPACE  2                                                                    TPR01670
KIKIT    ABEND  3,DUMP         SHOULDNT EVER GET HERE, CRASH                         TPR01680
         SPACE  2                                                                    TPR01690
ONWITHIT OPEN   (TPDCB,INPUT)                                                        TPR01700
         TM     DCBOFLGS,X'10' DID STUPID THING OBEY?                                TPR01710
         BNO    KIKIT           NOPE, GO PUNT                                        TPR01720
         L      R9,DCBDEBAD    GET POINTER AND DEVICE STATISTICS TABLE               TPR01730
         L      R9,32(R9)       GET UCB ADDR OUT OF DEB                              TPR01740
         SR     R6,R6                                                                TPR01750
         IC     R6,9(R9)       GET STAT TABLE POINTER                                TPR01760
         MH     R6,=H'10'      POINTER * 10                                          TPR01770
         L      R9,16          POINTER TO CVT                                        TPR01780
         L      R9,112(R9)     POINTER TO STAT TABLE START                           TPR01790
         LA     R9,0(R6,R9)     GOTCHA STAT TABLE                                    TPR01800
         ST     R9,STATTAB     SAVE ADDRESS OF STAT TABLE                            TPR01810
         MVC    OLDSTAT,0(R9)   SAVE ITS INFO                                        TPR01820
         SPACE  2                                                                    TPR01830
OOKK     L      R0,SHOVALN  GET BLKSIZE FOR TAPE EXCP BUFFER                         TPR01840
         STH    R0,BYTCNT      PUT DATA LENGTH INTC CCW                              TPR01850
         L      R1,SHOVAAD                                                           TPR01860
         ST     R1,TPBUFLOC                                                          TPR01870
         MVC    TPBLOC,TPBUFLOC+1  PUT BUFFER LOC IN CCW                             TPR01880
         LTR    R0,R0                                                                TPR01890
         BP     OOKKK                                                                TPR01900
         MVI    TPCCW,X'37'                                                          TPR01910
         BAL    R9,TPGET                                                             TPR01920
         MVI    TPCCW,X'02'                                                          TPR01930
         BAL    R9,TPWAIT                                                            TPR01940
         B      RETURN                                                               TPR01950
         SPACE  2                                                                    TPR01960
         SPACE  2                                                                    TPR01970
OOKKK    BAL    R9,TPGET       GO READ A BUFFER                                      TPR01980
         SPACE  2                                                                    TPR01990
         BAL  R9,TPWAIT        GO WAIT TILL READ FINISHED                            TPR02000
RETURN   LA     R15,0          NORMAL RETURN, MODIFIED ELSEWHERE                     TPR02010
         L      R13,4(R13)     RESTORE REGISTERS                                     TPR02020
         L      R14,12(R13)                                                          TPR02030
         LM     R0,R12,20(R13)                                                       TPR02040
         BR     R14            ALL RETURNS THRU HERE                                 TPR02050
         SPACE  2                                                                    TPR02060
TPEOF    MVI    RETURN+3,X'04'  SET EOF RETURN                                       TPR02070
         SPACE  2                                                                    TPR02080
OUT      CLOSE  TPDCB                                                                TPR02090
         SPACE  2                                                                    TPR02100
         MVI    BADBOMB,X'AA'  TURN ON FLAG                                          TPR02110
```

```
         B     RETURN
         SPACE 2
GETSTAT  L     R9,STATTAB        ARRIVE HERE ON BAD READ
         MVC   NEWSTAT,0(R9)      GET CURRENT STAT TABLE
         L     R9,SHOVAAD        MOVE OLD AND NEW STAT TABLES TO FTN
         MVC   0(16,R9),OLDSTAT    ARRAY BEFORE ERROR RETURN
         MVI   RETURN+3,X'08'     SET I/O ERROR RETURN
         B     OUT
         SPACE 2
TPGET    MVI   TPECB,X'00'       CLEAR ECB
         MVC   TPEXCP,TPCCW
         MVI   RDFLG,X'FF'       TURN ON READ FLAG
         EXCP  TPIOB             DO IT
         BR    R9                RETURN
         SPACE 2
TPWAIT   TM    TPECB,X'40'       IS IT ALREADY DONE?
         BO    NOWAIT            YES
         WAIT  ECB=TPECB         NO,WAIT FOR IT
NOWAIT   CLI   TPECB,X'7F'       DID IT DO IT OK?
         BE    OK1               YES,CONTINUE
         SPACE 2
         CLI   TPCSW+3,X'0D'   PROBABLE EOF IF CHAN-DEV END & UNIT EXCPT
         BNE   GETSTAT         NOPE, GO FIND ERROR
         CLI   FLAGS1,X'04'     EXCEPTIONAL CONDIT BIT ON? (=EOF)
         BNE   GETSTAT         NO EOF
         L     R1,DCBBLKCT       DECREMENT  DCBBLKCT SO IT MATCHES TAPE
         BCTR  R1,0                     TRAILER LABELS
         ST    R1,DCBBLKCT
         EOV   TPDCB           YES,EOF - FORCE CONTROL TO EODAD RTN
         SPACE 2
OK1      BR    R9                  RETURN
         SPACE 2
SAV1     DC    18F'0'
         SPACE 2
OLDSTAT  DC    D'0'              COPY OF STAT TABLE AFTER OPEN
NEWSTAT  DC    D'0'              COPY OF STAT TABLE UPON ERROR
         SPACE 2
TPEXCP   DC    D'0'            LOC CONTAINING CCW BEING USED
TPCCW    DC    X'02'             READ
TPBLOC   DC    AL3(0)            DATA ADDRESS
FLGS     DC    X'20'             SUPPRESS INCORRECT LNGT
BYTCNT   DC    H'0'              BYTE COUNT
         SPACE 2
SHOVSMF  DC    A(0)              LOC OF SMF INFO
SHOVAAD  DC    A(0)              ADDR OF FORTRAN ARRAY
SHOVALN  DC    F'0'              BYTE LENGTH OF FORTRAN ARRAY
         SPACE 2
TPBUFLOC DC    A(0)              LOC OF DCBBLKSI LENGTH TAPE BUFFER
```

```
         SPACE 2                                                        TPR02600
STATTAB  DC    A(0)            LOC OF STAT TABLE                         TPR02610
         SPACE 2                                                        TPR02620
         SPACE 2                                                        TPR02630
RDFLG    DC    X'00'            =X'FF' AFTER READ, BEFORE WAIT           TPR02640
BADBOMB  DC    X'00'           FLAG TO TELL WHETHER DCB USED BEFORE      TPR02650
         SPACE 2                                                        TPR02660
TPDCB    DCB   DDNAME=METTAP,MACRF=(E),EODAD=TPEOF,DSORG=PS,           *TPR02670
               IOBAD=TPIOB,DEVD=TA                                      TPR02680
         SPACE 2                                                        TPR02690
         DS    0F                                                       TPR02700
TPIOB    DS    0CL32                                                    TPR02710
FLAGS1   DC    X'00'                                                    TPR02720
FALGS2   DC    X'00'                                                    TPR02730
SENSE1   DC    X'00'                                                    TPR02740
SENS2   DC    X'00'                                                     TPR02750
ECBCOD   DC    X'00'                                                    TPR02760
ECBADD   DC    AL3(TPECB)                                               TPR02770
FALGS3   DC    X'00'                                                    TPR02780
TPCSW   DC    7X'00'                                                    TPR02790
SIOCODE  DC    X'00'                                                    TPR02800
EXCPADD  DC    AL3(TPEXCP)                                              TPR02810
RESERC   DC    X'00'                                                    TPR02820
DCBADDR  DC    AL3(TPDCB)                                               TPR02830
REPOMOD  DC    X'00'                                                    TPR02840
RESTADR  DC    AL3(0)                                                   TPR02850
BLCINC  DC    H'1'                                                      TPR02860
ERORCNT  DC    H'0'                                                     TPR02870
         SPACE 2                                                        TPR02880
TPECB    DC    F'0'                                                     TPR02890
         SPACE 2                                                        TPR02900
ARGS     DSECT                                                          TPR02910
AADD     DC    A(0)            ADDRESS OF FORTRAN ARRAY                  TPR02920
ALADD    DC    A(0)            ADDRESS OF LENGTH OF FORTRAN ARRAY        TPR02930
         SPACE 2                                                        TPR02940
         PRINT NOGEN                                                    TPR02950
         DCBD  DSORG=PS,DEVD=TA                                         TPR02960
         PRINT GEN                                                      TPR02970
         SPACE 2                                                        TPR02980
TPRD    CSECT                                                           TPR02990
         LTORG                                                          TPR03000
         END                                                            TPR03010
```

APPENDIX C

```
C TITLE          HYDRO - A MODIFIED VERSION

C PROGRAMMER     R.E.GREER MODIFIED AN ORIGINAL PROGRAM,HYDRO, DEVELOPED
C                BY THE U.S. NAVAL POSTGRADUATE SCHOOL, DEPARTMENT OF
C                OCEANOGRAPHY.

C PURPOSE        THE PROGRAM READS AND INTERPOLATES TEMPERATURE AND
C                SALINITY DATA FOR 'STANDARD DEPTHS' AND CALCULATES
C                SIGMA-T, SPECIFIC VOLUME ANOMALY, SOUND VELOCITY,
C                DYNAMIC HEIGHT, DYNAMIC HEIGHT ANOMALY, AND GEOSTROPHIC
C                CURRENTS AND TRANSPORT.

C MODIFICATIONS  THE ORIGINAL PROGRAM HYDRO HAS BEEN MODIFIED TO
C                INCLUDE AN INCREASED CAPABILITY TO PROCESS TEMPERATURE
C                AND SALINITY DATA ON A VERTICAL DEPTH SCALE INTERVAL AS
C                FINE AS 2.5 METERS,AND A CARD PUNCHING ROUTINE WHICH
C                PRODUCES COMPOSITE DATA CARDS, EACH CONTAINING DEPTH,
C                TEMPERATURE, SALINITY, GEOSTROPHIC VELOCITY, DYNAMIC
C                HEIGHTS, AND MASS TRANSPORT. MODIFICATIONS AFFECT ONLY
C                THE MAIN PROGRAM AND SUBROUTINE GEOCUR.

C DATE           26 JUNE 1975

      REAL *8 ITL(12),INFO(200,4)
      DIMENSION ID(200),IT(200),IS(200),IO(200)
      DIMENSION D(200),T(200),S(200),O2(200),SNDV(98)
      DIMENSION SD(98),ST(98),SS(98),SGT(98),SV(98),SVA(98)
      DIMENSION SGP(200),DH(98),BDH(98),DD(98),SLEV(48),BSVA(98)
      DIMENSION NPA(48),NPB(48),NO(48),NSTA(48,3),ALT(48),ALM(48)
      DIMENSION ALN(48),ANM(48),IDATE(48,3),DHT(48,98),ADH(98)
      COMMON /INFO/ ASS(2000),ASGT(2000),AST(2000),KB
    8 FORMAT (1H1,'STATION,',3A4,' LATITUDE ',I2,F5.1,'N LONGITUDE ',
     1I3,F5.1,'W  DATE ',3A4/5X,' TO,',3A4,' LATITUDE ',I2,F5.1,
     2'N LONGITUDE ',I3,F5.1,'W  DATE ',3A4//)
    9 FORMAT (8(1X,2I2,F5.0))
   10 FORMAT (1H1,'STATION ',3A4,' LATITUDE = ',I2,F5.1,'N LONGITUDE =',
     1I4,F5.1,'W  DATE ',3A4//)
   11 FORMAT (10X,'* INDICATES ADJUSTED VALUE')
   12 FORMAT (10X,'? INDICATES QUESTIONABLE VALUE')
   99 FORMAT (10X,'X INDICATES NO VALUE')
   13 FORMAT (I4,3A4,F4.0,F4.1,F4.0,F5.1,3A4)
   15 FORMAT (F8.1,A1,1X,F9.2,A1,F10.3,A1,F9.3,A1,7X;4A8)
```

```
   16 FORMAT (10X,'DEPTH  TEMPERATURE  SALINITY  SIGMA-T  OXYGEN'//)
   17 FORMAT (20X,'OBSERVED VALUES'//)
   18 FORMAT (//20X,'INTERPOLATED VALUES'//)
   19 FORMAT (10X,'DEPTH  TEMPERATURE  SALINITY  SIGMA-T   SND VEL   SPE
     1C VOL  SPEC V ANOM  MEAN SVA   DELTA D  DYNAMIC HEIGHT'//)
   20 FORMAT(10X,F5.0,F10.2,F12.3,F9.3,F12.2,F10.4,F12.6,25X,F10.5/80X,
     12F12.6)
   21 FORMAT (10X,F6.1,A1,F8.2,A1,F11.3,A1,F8.3,F9.3,A1,4X,4A8/)
      DATA SD/0.,5.,10.,15.,20.,25.,30.,35.,40.,45.,50.,55.,60.,65.,70.,
     175.,80.,85.,90.,95.,100.,105.,110.,115.,120.,125.,130.,135.,140.,
     2145.,150.,155.,160.,165.,170.,175.,180.,185.,190.,195.,200.,205.,
     3210.,215.,220.,225.,230.,235.,240.,245.,250.,255.,260.,265.,270.,
     4275.,280.,285.,290.,295.,300.,310.,320.,330.,340.,350.,375.,400.,
     5425.,450.,475.,500.,525.,550.,575.,600.,625.,650.,675.,700.,725.,
     6750.,775.,800.,825.,850.,900.,1000.,1100.,1200.,1300.,1500.,1700.,
     72000.,2500.,3000.,4000.,5000./
C
C         READ THE NUMBER OF GEOSTROPHIC CURRENTS & TRANSPORTS
C         TO BE CALCULATED
C
      READ (5,13) NGC
      IF(NGC.EQ.0) GO TO 410
      READ (5,9) (NPA(I),NPB(I),SLEV(I),I=1,NGC)
  410 NPA(NGC+1)=0
      M=1
      KB=1
  999 FORMAT(1X,'  KB = ',I8,///)
      WRITE(6,999) KB
      DO 41 L=1,48
C
C         READ HEADING CARD, CHECK FOR  END OF DATA, THEN
C         READ NOV DATA CARDS.
C
      READ (5,13) NOV,(NSTA(L,K),K=1,3),ALT(L),ALM(L),ALN(L),ANM(L),
     1(IDATE(L,K),K=1,3)
      IF (NOV) 32,32,24
   24 DO 25 I=1,NOV
      READ (5,15) D(I),ID(I),T(I),IT(I),S(I),IS(I),O2(I),IO(I),
     1(INFO(I,J),J=1,4)
C
C         SGTSVA IS SUBROUTINE TO COMPUTE SIGMA-T, SPECIFIC VOLUME
C         AND SPECIFIC VOLUME ANOMALY.
C
   25 CALL SGTSVA (T(I),S(I),D(I),SGP(I),SVNO,SVNO)
C
C         LGTP IS SUBROUTINE TO COMPUTE INTERPOLATED VALUES
C
      CALL LGTP(NOV,D,T,SD,ST,NA)
```

```
      CALL LGTP(NOV,D,S,SD,SS,NB)
      NO(L)=NA
      DO 27 I=1,NA
C
C         SNDVEL IS SUBROUTINE TO COMPUTE SOUND VELOCITY
C
      CALL SNDVEL (ST(I),SS(I),SD(I),SNDV(I))
      CALL SGTSVA (ST(I),SS(I),SD(I),SGT(I),SV(I),SVA(I))
   27 CONTINUE
      NLT=ALT(L)
      NLN=ALN(L)
      WRITE (6,10) (NSTA(L,K),K=1,3),NLT,ALM(L),NLN,ANM(L),
     1(IDATE(L,K),K=1,3)
      WRITE (6,18)
      WRITE(6,19)
      NA=NA-1
      DH(1)=0.
      DO 30 I=1,NA
      BSVA(I)=(SVA(I)+SVA(I+1))*.5
      DD(I)=BSVA(I)*(SD(I+1)-SD(I))
   30 DH(I+1)=DH(I)+DD(I)
      DO 31 I=1,NA
      DHT(L,I)=DH(I)
      ASS(M)=SS(I)
      ASGT(M)=SGT(I)
      AST(M)=ST(I)
      M=M+1
   31 WRITE (6,20) SD(I),ST(I),SS(I),SGT(I),SNDV(I),SV(I),SVA(I),DH(I),
     1BSVA(I),DD(I)
      I=NA+1
      DHT(L,I)=DH(I)
      ASS(M)=SS(I)
      ASGT(M)=SGT(I)
      AST(M)=ST(I)
      M=M+1
      WRITE (6,20) SD(I),ST(I),SS(I),SGT(I),SNDV(I),SV(I),SVA(I),DH(I)
    3 FORMAT(1X,'  M = ',I4,///)
      WRITE(6,3) M
   41 CONTINUE
      IF(NGC.EQ.0) GO TO 33
   32 DO 42 L=1,48
      IF (NPA(L).EQ.0) GO TO 33
      BASE=SLEV(L)
      N1=NPA(L)
      N2=NPB(L)
      NU1=NO(N1)
      NU2=NO(N2)
      DO 43 I=1,NU1
```

```
   43 ADH(I)=DHT(N1,I)
      DO 44 I=1,NU2
   44 BDH(I)=DHT(N2,I)
      NLT=ALT(N1)
      NLN=ALN(N1)
      MLT=ALT(N2)
      MLN=ALN(N2)
  130 FORMAT(1X,3A4,I4)
      ISAVE=(NU1/2.0)+1.0
      IF(ISAVE.EQ.37) GO TO 131
      ISAVE=37
  131 WRITE(6,130) (NSTA(N1,K),K=1,3),ISAVE
      WRITE(7,130) (NSTA(N1,K),K=1,3),ISAVE
      WRITE (6,8) (NSTA(N1,K),K=1,3),NLT,ALM(N1),NLN,ANM(N1),
     1(IDATE(N1,K),K=1,3),(NSTA(N2,K),K=1,3),MLT,ALM(N2),MLN,
     2ANM(N2),(IDATE(N2,K),K=1,3)
      ALAT=ALT(N1)+ALM(N1)/60.
      ALON=ALN(N1)+ANM(N1)/60.
      BLAT=ALT(N2)+ALM(N2)/60.
      BLON=ALN(N2)+ANM(N2)/60.
C
C         DSTSTA IS SUBROUTINE TO COMPUTE DISTANCE BETWEEN STATIONS
C
      CALL DSTSTA (ALAT,ALON,BLAT,BLON,X2,DIST)
C
C         GEOCUR IS SUBROUTINE TO COMPUTE GEOSTROPHIC CURRENTS
C         AND TRANSPORTS
C
   42 CALL GEOCUR(NU1,ADH,NU2,BDH,SD,BASE,X2,NNN,DIST)
   33 STOP
      END
```

```
      SUBROUTINE:GEOCUR(NA,ADH,NB,BDH,SD,BASE,X2,NNN,DIST)
      DIMENSICN ADH(NA),BDH(NB),SD(98),RVEL(98),VEL(98),AMB(98),AVT(98)
      CCMMON /INFO/ ASS(2000),ASGT(2000),AST(2000),KB
   10 FORMAT (13X,'DEPTH     DYN HT     DYN HT     DIFF HT    REL VEL    ABS
     1VEL    ABS VOL'/14X,' M.          STA A      STA B        A-B       CM/SEC
     2     CM/SEC    TRANSPORT *'/)
   11 FORMAT(13X,F5.0,2X,3(F9.5,1X),2(F8.2,2X)/72X,F9.5)
   12 FORMAT ('***** LEVEL OF NO MOTION MUST BE EQUAL TO A STANDARD DEPT
     1H *****')
   14 FORMAT(' ',10X,'TOTAL VOLUME TRANSPORT IS COMPUTED BY SUMMING INCR
     1EMENTAL TRANSPORTS ABOVE LEVEL OF NO MOTION:'//5X,'TOTAL TRANSPORT
     2 PERPENDICULAR TO THE PLANE OF THE STATIONS IS ',F7.3,' SVERDRUPS
     3RELATIVE TO ',F5.0,' METERS')
   15 FORMAT(//'  * VALUES IN THIS COLUMN REPRESENT TRANSPORTS IN LAYER
     1INCREMENTS'//)
      IF(NA.LE.NB) GO TO 51
      N=NB
      GO TO 52
   51 N=NA
   52 DO 53 I=1,N
      AMB(I)=ADH(I)-BDH(I)
   53 RVEL(I)=-AMB(I)*X2
      DC 54 I=1,98
      IF(BASE.EQ.SD(I))GO TO 55
   54 CONTINUE
      WRITE (6,12)
      GO TO 70
   55 NM=I
      IF(NM.GT.N) NM=N
      BASE=SD(NM)
      DC 56 I=1,N
   56 VEL(I)=RVEL(I)-RVEL(NM)
      DO 553 I=2,N
      J=I-1
      AVEL=(VEL(I)+VEL(J))*0.005
  553 AVT(J)=AVEL*DIST*(SD(I)-SD(J))*1.0E-03
      NM=NM-1
      VT=0.
      DO 57 I=1,NM
   57 VT=VT+AVT(I)
C
C  IF STATION A IS TO THE RIGHT OF STATION B AS AN OBSERVER LOOKS AT
C  THE PLANE OF THE STATIONS, A POSITIVE CURRENT FLOWS AWAY FROM THE
C  OBSERVER.
C
   58 WRITE (6,10)
      N=N-1
      DO 60 I=1,N
```

```
 60 WRITE (6,11) SD(I),ADH(I),BDH(I),AMB(I),RVEL(I),VEL(I),AVT(I)
    N=N+1
    I=N
    WRITE (6,11) SD(I),ADH(I),BDH(I),AMB(I),RVEL(I),VEL(I)
    NNN=N
    WRITE(6,15)
    WRITE(6,14)VT,BASE
100 FORMAT(1X,F4.0,2F8.3,F9.2,F7.0,2F5.0,F7.2,F8.2,F10.5,2I4)
110 FORMAT(1X,'SD',5X,'SS',6X,'SGT',6X,'VEL',5X,'VEL',3X,'ADH',2X,
   1'BDH',3X,'ST',5X,'RVEL',5X,'AVT',4X,'J',3X,'K',//)
120 FORMAT('1')
125 FORMAT('0')
130 FORMAT(1X,F4.0,2F8.3,F9.2,F7.0,2F5.0,F7.2,F8.2,10X,2I4)
    WRITE(6,120)
    WRITE(6,125)
    WRITE(6,110)
    K=1
  5 FORMAT(1X,'  KB = ',I4,///)
    WRITE(6,5) KB
 45 DO 50 J=1,N,2
    ADH(J)=(ADH(N)-ADH(J))*100
    BDH(J)=(BDH(N)-BDH(J))*100
    WRITE(6,100) SD(J),ASS(KB),ASGT(KB),VEL( J),VEL(J),ADH(J),BDH(J),
   1AST(KB),RVEL(J),AVT(J),J,K
    WRITE(7,100) SD(J),ASS(KB),ASGT(KB),VEL( J),VEL(J),ADH(J),BDH(J),
   1AST(KB),RVEL(J),AVT(J),J,K
    K=K+1
    JSCAR=J
    KB=KB+2
 50 CONTINUE
    J=JSCAR+1
    KB=KB-1
    ADH(N)=0.0
    BDH(N)=0.0
    WRITE(6,130) SD(N),ASS(KB),ASGT(KB),VEL(N),VEL(N),ADH(N),BDH(N),
   1AST(KB),RVEL(N),J,K
    WRITE(7,130) SD(N),ASS(KB),ASGT(KB),VEL(N),VEL(N),ADH(N),BDH(N),
   1AST(KB),RVEL(N),J,K
    KB=KB+1
 70 RETURN
    END
```

```
      SUBROUTINE DSTSTA(SATI,ONGI,SATII,ONGII,X2,DIST)
      IMPLICIT REAL*4 (K)
      REAL*8 A,E
      DATA A/111132.09/,B/566.05/,C/1.20/,D/.002/
      DATA E/111415.13/,F/94.55/,G/.012/
   10 FORMAT (10X,'MEAN LATITUDE = ',F6.2/15X,'DISTANCE = ',F6.2,
     1' KILOMETERS'/)
      CCN=2*3.1416/360
      AATI=SATI*CON
      AATII=SATII*CON
      $MERI=A-B*COS(2*AATI)+C*COS(4*AATI)-D*COS(6*AATI)
      PARI=E*COS(AATI)-F*COS(3*AATI)+G*COS(5*AATI)
      $MERII=A-B*COS(2*AATII)+C*COS(4*AATII)-D*COS(6*AATII)
      PARII=E*COS(AATII)-F*COS(3*AATII)+G*COS(5*AATII)
      ALLAT=($MERI+$MERII)/2
      ALLCN=(PARI+PARII)/2
      DLAT=SATI-SATII
      DLON=ONGI-ONGII
      KLAT=DLAT*ALLAT/1000
      KLONG=DLON*ALLON/1000
      KDIX=SQRT(KLAT**2+KLONG**2)
      DIST=KDIX
      W2=1.458E-4
      PSI=(SATI+SATII)*0.5
      PSJ=(2.*3.14159/360.)*PSI
      SPSI=SIN(PSJ)
      IF(SPSI.LT.0.1) SPSI=0.1
      X2=1./(W2*SPSI*KDIX)
      WRITE(6,10) PSI,KDIX
      RETURN
      END
```

```
      SUBROUTINE LGTP(N,D,V,SD,CV,NN)
      DIMENSION D(N),V(N),CV(98),SD(98)
  111 DO 188 J=1,98
  112 DO 186 I=1,N
      IF(SD(J)-D(N))113,115,190
  115 CV(J)=V(N)
      GO TO 191
  113 IF(SD(J)-D(I))114,114,116
  114 CV(J)=V(I)
      GO TO 188
  116 IF(SD(J)-D(I+1))120,118,186
  118 CV(J)=V(I+1)
      GO TO 188
  120 IF(I-1)132,132,126
  126 XA=(SD(J)-D(I))*(SD(J)-D(I+1))*V(I-1)/
     1((D(I-1)-D(I))*(D(I-1)-D(I+1)))
      XB=(SD(J)-D(I-1))*(SD(J)-D(I+1))*V(I)/
     1((D(I)-D(I-1))*(D(I)-D(I+1)))
      XC=(SD(J)-D(I-1))*(SD(J)-D(I))*V(I+1)/
     1((D(I+1)-D(I-1))*(D(I+1)-D(I)))
      ANSU=XA+XB+XC
  132 IF ((I+2)-N)133,133,134
  133 YA=(SD(J)-D(I+1))*(SD(J)-D(I+2))*V(I)/
     1((D(I)-D(I+1))*(D(I)-D(I+2)))
      YB=(SD(J)-D(I))*(SD(J)-D(I+2))*V(I+1)/
     1((D(I+1)-D(I))*(D(I+1)-D(I+2)))
      YC=(SD(J)-D(I))*(SD(J)-D(I+1))*V(I+2)/
     1((D(I+2)-D(I))*(D(I+2)-D(I+1)))
      ANSD=YA+YB+YC
  134 ZA=(SD(J)-D(I+1))*V(I)/(D(I)-D(I+1))
      ZB=(SD(J)-D(I))*V(I+1)/(D(I+1)-D(I))
      ANSL=ZA+ZB
      IF(I-1)136,136,138
  136 CV(J)=(ANSD+ANSL)/2.
      DLL=(ANSD+ANSL+ANSL)/3.
      GO TO 188
  138 IF((I+2)-N)140,140,142
  140 CV(J)=(ANSU+ANSD+ANSL)/3.
      UD=(ANSU+ANSD)/2.
      GO TO 188
  142 CV(J)=(ANSU+ANSL)/2.
      ULL=(ANSU+ANSL+ANSL)/3.
      GO TO 188
```

```
186 CONTINUE
188 CONTINUE
190 J=J-1
191 NN=J
    RETURN
    END
```

```
      SUBROUTINE SNDVEL (T,S,D,SVL)
      IF(D.LE.100.) GO TO 10
      IF(D.LE.200.) GO TO 20
      IF(D.LE.400.) GO TO 30
      IF(D.LE.700.) GO TO 40
      IF(D.LE.1500.)GO TO 50
      IF(D.LE.2000.)GO TO 60
      P=D*(.10318+(D-2000.)*2.6E-7)
      GL TO 5
   10 P=D*(.10245+D*3.0E-7)
      GO TO 5
   20 P=D*(.10248+(D-100.)*7.0E-7)
      GO TO 5
   30 P=D*(.10255+(D-200.)*6.0E-7)
      GC TO 5
   40 P=D*(.10267+(D-400.)*4.33E-7)
      GO TO 5
   50 P=D*(.10280+(D-700.)*3.0E-7)
      GO TO 5
   60 P=D*(.10304+(D-1500.)*2.7E-7)
    5 CONTINUE
      VT=T*(4.5721-T*(.044532-T*(2.6045E-4+T*(7.9851E-6))))
      VP=P*(.160272+P*(1.0268E-5+P*(3.5216E-9-P*(3.3603E-12))))
      VS=(S-35.)*(1.39799+(S-35.)*1.69202E-3)
      A1=T*(-.011244+3.1580E-8*P+T*(7.7711E-7+1.5790E-9*P))
      A2=P*(7.7016E-5-1.2943E-7*P)
      A3=P*T*(-1.8607E-4+T*(7.4812E-6+T*(4.5283E-8)))
      A4=P*P*(T*(-2.5294E-7+T*1.8563E-9)+P*T*(-1.9646E-10))
      SVL=1449.14+VT+VP+VS+(S-35.)*(A1+A2)+A3+A4
      RETURN
      END
```

```
      SUBROUTINE SGTSVA (T,S,D,SGT,SV,SVA)
      ST=-(((T-3.98)**2)/503.57)*((T+283.)/(T+67.26))
      CL=(S-.030)/1.805
      SO=-.069+1.4708*CL-.00157*CL**2+3.98E-5*CL**3
C
C          ALTERNATE METHOD OF COMPUTING SIGMA-ZERO:
C          SO=-0.093+0.8149*S-.000482*S**2+6.8E-6*S**3
C
      AT=T*(4.7867-.098185*T+.0010843*T**2)*1.E-3
      BT=T*(18.030-.8164*T+.01667*T**2)*1.E-6
      SGT=ST+(SO+.1324)*(1.-AT+BT*(SO-.1324))
      AFST=1./(1.+SGT*1.E-3)
      A=D*AFST*1.E-9
      B=4886./(1.+1.83E-5*D)
      C=227.+28.33*T-.551*T**2+.004*T**3
      E=D*1.E-4
      G=(SO-28.)/10.
      H=147.3-2.72*T+.04*T**2
      U=105.5+9.5*T-.158*T**2
      V=1.5*D**2*T*1.E-8
      W=32.4-.87*T+.02*T**2
      X=4.5-.1*T
      Y=1.8-.06*T
      SV=AFST-A*(B-C+E*U-V-G*(H-E*W)+G**2*(X-E*Y))
      AZ=.972643
      YA=-227.+.01055*D
      YB=.0126*(147.3-.00324*D)
      AP=AZ-D*AZ*(B+YA-YB)*1.E-9
      SVA=SV-AP
      RETURN
      END
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